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Rapid Erection of Steel Coal Breaker

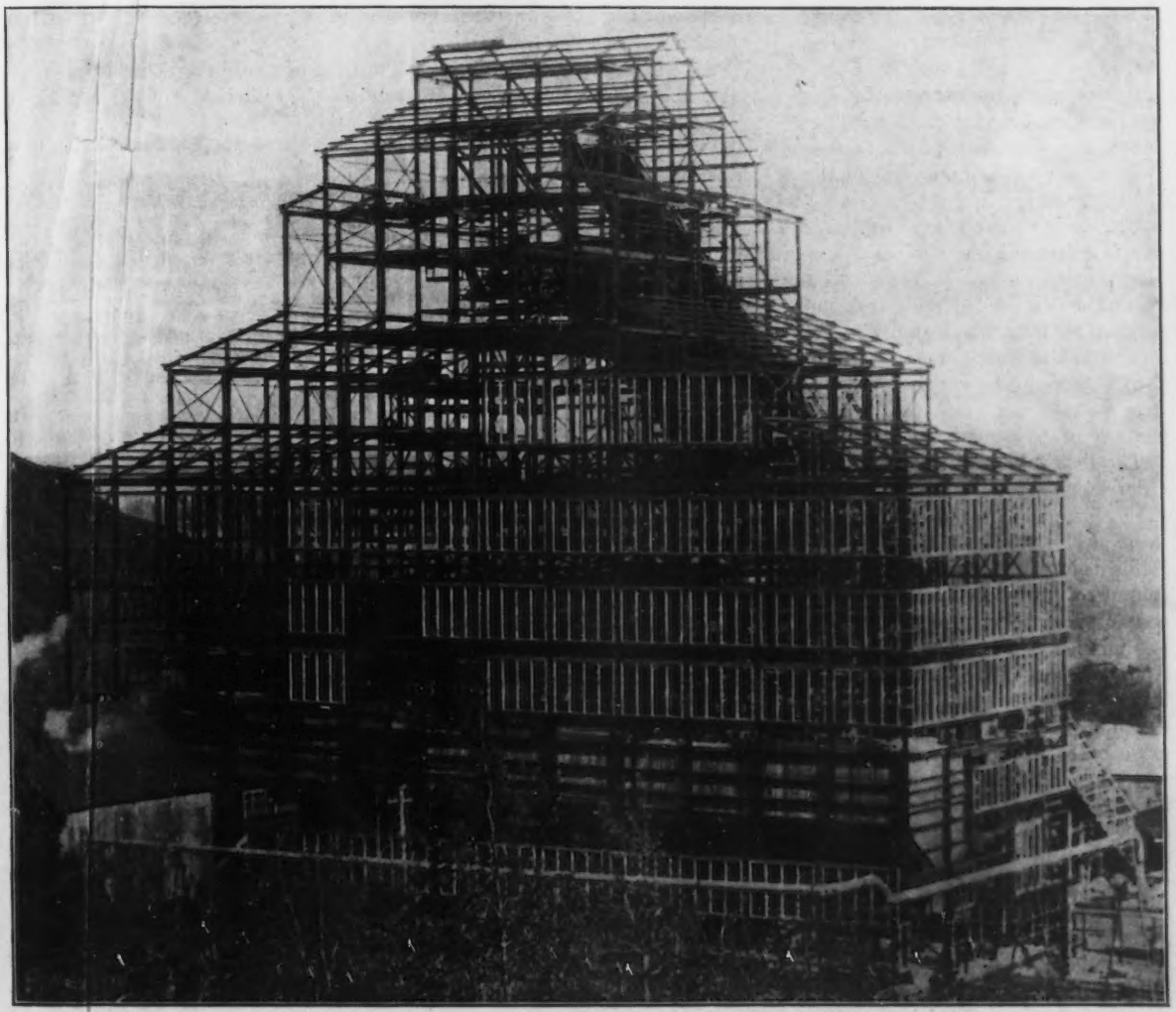
By C. Stuart Phillips*

Practically the last great industry to cling to the use of heavy timber framing for permanent construction has been the anthracite industry of Pennsylvania; but within the last three years the wooden coal breaker has started to go the way of the wooden ship and the wooden bridge.

One of the first companies to abandon the old type was the Lehigh Valley Coal Co., which three years ago rebuilt its Mineral Springs and Franklin breakers of structural steel. In the short time following there have been placed in operation two other steel breakers in the Wyoming Valley, two in the Schuylkill district, and at present three more are in process of erection in the former district and two in the Hazleton district.

The timber breaker is highly inflammable, framing, floors, siding, roof, pockets and bins being of wood, usually yellow pine. Three disastrous fires, one with loss of life, within the last year have emphasized its danger. The Ewen breaker of the Pennsylvania Coal Co. in the Wyom-

*G. B. Markle Co., Jeddo, Penn.



Structural-Steel Coal Breaker, Highland No. 5, Hazleton, Penn., 91 Days after Contract for Erection Was Signed

ing Valley, the Lattimer No. 1 breaker of the Pardee Coal Co., and the Highland No. 5 breaker of the G. B. Markle Co. in the Hazleton district each burned to the ground, being completely lost in two or three hours. In the last-mentioned case the fire was with difficulty kept from spreading down the slope to the mines, the whole plane having to be dynamited to prevent this occurrence.

All these breakers are being rebuilt of steel, and the Markle company is replacing several of its timber planes with steel, to prevent possible conflagrations in the wooden breakers spreading to the mines.

The erection of the new breaker at Highland No. 5 has been interesting because an enviable record for speed has been establishd for this type of construction. The old breaker burned on Jan. 15, 1915, and the contract for the new steel structure was signed on Feb. 9. The Guerber Engineering Co., of Bethlehem, Penn., did the design and detailing and furnished and erected the steel.

On account of the expense entailed in hauling the coal, until the new breaker is in operation, from this mine to a breaker 2 mi. distant, to be crushed, cleaned, and assorted, the coal company let the contract on the basis of a $75-per-day bonus or penalty from May 19, one hundred days after the signing of the contract.

Seven designers were sent to the G. B. Markle Co.'s offices at Jeddo the day after the agreement was concluded. These men worked 14 hr. a day, consulting the coal company's engineers as to panel lengths, machinery locations, loadings, etc. As fast as one section was designed and approved, prints were sent to the detailers at Bethlehem. On the approval of the first batch of details the shop started fabrication.

The design was finished by Feb. 26, and the following day the first shipment of steel was received on the site. The previous week the erecting gang had come on the ground and unloaded their tools and erected the derrick, so that no time was lost. The débris had been cleared away and the foundations got into shape by the coal company's forces. The working time was 10½ hr. a day, seven days a week; but much time was lost, 12 days in all, on account of bad weather.

The field organization consisted of an unloading gang, a derrick gang, a handline erecting gang, and four riveting gangs. The derrick used was a stiff-leg, 5-ton, 100-ft. boom steel derrick, set in the center of the building. The latter being 158 ft. long and 75 ft. wide, the corner columns were reached from the center set-up. When the erection had progressed to the 35-ft. height the derrick was jumped up to that floor and again to the 75-ft. height, from which elevation the rest of the steel was set, 148 ft. being the maximum height in the center of the building, stepping down to about 90 ft. at the two ends. At each move of the derrick three-quarters of the steel was set with the boom outside the stiff-legs; the boom jumped inside the legs to erect the remaining quadrant. Two panels near the center were left open, as the derrick frame was hoisted up bodily each time the rig was raised, using the boom as a ginpole. When the rest of the erection was completed the derrick frame was dismantled and lowered to the ground and these two panels erected with the boom as a ginpole.

The wind bracing, channel girts for the corrugated siding, etc., were erected by handline. The riveting was done by compressed air furnished by the coal company, Ingersoll-Rand pneumatic hammers being used. In the writer's experience the Boyer hammer has usually been the most satisfactory on all-around bridge and building work, but the Ingersoll-Rand proved the best on this work, being shorter than the Boyer and more easily manipulated in the close quarters, due to the wide flanges of the Bethlehem sections.

Altogether there are 736 tons in the structure, 25,000 rivets, 8300 bolts, and 900 tie-rods, small castings, etc.; 3000 pieces were erected by the derrick and 1700 by handline.

The first column was erected Feb. 28 and the first rivet driven Mar. 14. The job was completed and accepted on May 11 (the date the accompanying photograph was taken), 91 days after the signing of the contract and 8 days before the contract time expired.

The coal company's carpenters started work on Apr. 18 on the wooden bins, pockets, floors, walks, chutes, etc. and the machinists began installing the heavy machinery shortly afterward. The corrugated siding and roofing have also been started, and the breaker will probably be in complete operation by Aug. 1—6½ months after the destruction of the old timber breaker.

Perry Sneathen had charge of the design, Victor Pfeiffer of the erection, for the Guerber Engineering Co., and the writer was engineer in charge of erection for the G. B. Markle Co.

In comparing this type of steel breaker with the standard timber construction, the following comparisons can be made:

1. Cost.—The contract price for the steel was between $65 and $70 per ton, totaling $44,000.

The framing for a timber breaker of like dimensions would necessitate about 510 M of lumber and would cost $25,000. While the initial cost of the steel is greater, the smaller insurance rates will in time equalize the two.

2. Speed of Erection.—The steel structure was erected, complete, in 60 working days, practically the time required to raise a timber frame. The first delivery of steel, however, was made 18 days after signing the contract. Yellow-pine timbers 12x12 in. and 14x14 in., in sufficient quantity cannot be obtained from the South in less than 60 days after placing an order; thus six weeks' time was saved by using steel construction.

3. Fire-Resisting Qualities.—The steel-frame breaker is far less inflammable than the timber frame. It is, however, by no means fireproof unless the remainder of the structure is in keeping.

In the breaker in question there is so much wood in the flooring, walkways, pockets, bins, window frames, etc., that it is quite possible that a fire could break out and generate sufficient heat to soften and weaken the steel columns and cause the whole structure to collapse. If a real fireproof structure is desired, the floors, dump and jig pockets and loading bins should all be of reinforced concrete, the walkways of iron and metal sash should be used for windows. In this connection it may be stated that wooden pockets and bins have to be renewed every five years. Reinforced-concrete walls costing 60 to 75 per cent. more in initial outlay would probably last three times as long.

Plans for the Ventilation of the new subway lines in New York City are to be considered by a board of engineers made up of Alfred Craven, Chief Engineer of the Public Service Commission; the consulting engineers of the Interborough Co., William Barclay Parsons and S. L. F. Deyo, and the consulting engineers of the New York Municipal Ry. Co., Jacobs & Davies and L. B. Stillwell. The present plan is to ventilate the subway by means of open gratings in the sidewalks. This plan is opposed by the merchants along Broadway on the ground that the gratings are avoided by pedestrians and prevent people from stopping to look into store windows.

The Binder Course in Asphalt Pavements

By Robert Klotz*

Present-day practice in sheet-asphalt and asphaltic or bituminous pavement construction for city streets and discussions of defects in such pavements show evidence of a constantly increasing tendency to overlook the purpose and importance of what is known as the "binder course," even to the extent of entirely eliminating this course or any substitute for it.

The various schemes and devices brought forward from time to time for the purpose of eliminating the wave effect met with in pavements of this character lead to the conclusion that a gentle reminder of the nature of and reason for the binder course might be of value to those interested in the question of economical pavement maintenance.

The purpose of the binder course is, as its name implies, to bind the top layer or wearing surface of the pavement to the base, whether the latter be of concrete, granite block, macadam or other material. The mixture used for the wearing surface is designed to form, under compression, a reasonably hard, durable and impervious covering, and being therefore comparatively low in bitumen has little if any power of adhesion.

The binder course originally used consisted of graded gravel thoroughly coated with coal tar, or coal-tar pitch, and laid at a temperature sufficiently high to provide for good adhesion to the base and to the surface layer.

The coal tar or pitch was later replaced by asphalt or asphaltic cement, presumably because of the increased difficulty of obtaining tar economically, due to the development of the water-gas process for the manufacture of illuminating gas and the consequent reduction in the quantity of commercial coal tar produced, and because of the decreased cost of the asphalt and its availability as part of the stock of the mixing plant. While the adhesive power of the binder thus produced was apparently lower than that of the tar-binder, it was still sufficient to provide the binding action required to prevent the forming of waves in the surface.

Within the last three or four years the various asphalt companies have introduced, apparently with a view to economy, what is commonly referred to as a close-mixture binder, which consists of broken stone screenings, varying from about a 1-in. size downward, covered with hot liquid asphalt. Owing probably to the reduced first cost of the pavement thus obtained, the use of this type of binder has been permitted under certain specifications, and quite a considerable area of this pavement has been laid.

The writer's experience with this type of binder, particularly on repair work, has shown that the old-style, or stone, binder is far more preferable and the one to be relied on to prevent the formation of waves in the pavement surface.

Owing to the decreased viscosity of the asphalt necessary to provide for the proper mixing of close-mixture binder, the coating on the particles of stone is comparatively thin. This makes the mixture subject to cooling below the critical temperature, within the time required for delivery and laying. The weight of the roller is more evenly distributed over the surface of contact between the binder and the base, and the pressure on the individual particles of stone is insufficient to bring the hotter portion of the more or less hardened coating into intimate contact with the base.

With new pavement the unfavorable behavior of the "close mixture" is less evident than when an old pavement is repaired, due, no doubt, to the greater care and the more exacting supervision.

The action of an asphalt pavement where no binder course is used was brought very clearly to the writer's attention during 1912, when he was in charge of certain pavement repairs in the city of New York, all of the work being subject to the city's specifications and inspection.

During the early part of that year an order was issued to the effect that when repairs were required on asphalt pavements where the thickness of the original pavement, consisting of 1 in. of binder and a 2 in. top course, had been reduced to 1½ in. or less (that being the newly specified thickness of the top course), the binder course was to be omitted.

The writer managed to avoid almost entirely the forming of waves in the pavement, which he felt certain would be the result of literal adherence to this order, by having the base spattered or painted with a coating of hot liquid asphalt immediately before laying the top-course mixture, this asphalt acting as a very efficient "glue." Repairs made under the direct supervision of the city authorities on the same streets and subject to the same traffic, without the thin but effective layer of adhesive, showed waves within from two to three days after laying, and were destroyed by the action of traffic within two or three weeks.

While various theories have been advanced from time to time to account for the waves formed in asphalt pavements, some of them apparently based upon sound reasoning, practical experience seems to show that whatever may be the particular action of traffic which causes them, waves can be avoided by providing a proper bond between the pavement proper and the base, and that three-wheel rollers, etc., are unnecessary and inadvisable complications to attempt to insert into the science of constructing and maintaining bituminous pavements.

An example of the need of special care in the construction of the binder course is shown in some work carried out by the writer in New York City in 1910, the area involving about 250 sq.yd. of sheet-asphalt pavement located in and around two underground-conduit car tracks with a double branch-off and curves, both being crossed constantly in the same direction by exceedingly heavy traffic. Frequent repairs had been required at this point owing to the rolling effect of traffic, the asphalt being continually forced against the rails and ground off as it reached the level of the head.

The relaying of the entire area was required upon the reconstruction of the tracks, and the work was carried out during the night and the early morning to permit laying of the pavement without seriously hindering traffic. Under the circumstances, the supervision of the city authorities was not as definite and exacting as might have been the case had the work been done during regular hours; and as the sub-base was known to be of a sufficiently dry and porous nature to permit of the proper setting of the base, the asphalt was laid on the "green" concrete, which had been in place from 3 to 12 hr.

*111 West 49th St., New York City.

This pavement remained in place for over 2½ years under the same traffic conditions as previously, the only repair required being one small patch where the asphalt had been disturbed by a loose rail joint.

Sad to relate, this area was almost entirely removed in connection with subway construction at the end of the time mentioned. A more extended record of its behavior would probably have been of considerable value, although the writer feels that the performance up to the time of removal was sufficiently marked to warrant more consideration of a proper joining of the pavement and the base than seems to be the practice at present.

Constructing the Fitchburg Sewage-Works

By Frank A. Marston*

SYNOPSIS—Features of the work were the 2½-in. cement-plaster and metal-lath walls of the Imhoff tanks and sprinkling filters, and the drainage system of the sprinkling filters. The sprinkling nozzles are also described.

Operation of the sewage-treatment works for the city of Fitchburg, Mass., was officially started on Oct. 8, 1914, and put into full swing a week later. The design of these works, consisting of Imhoff settling tanks, sludge beds 10 ft. deep, sprinkling filters and secondary settling tanks, was described in Engineering News, June 5, 1913, page 1176. As a number of the details are unusual, it may be of interest to consider them in view of the knowledge gained during construction.

The thin partition walls in the Imhoff tanks were constructed of 1½- to 2-in. cement plaster on rib-metal reinforcing lath of the type known as rib-trus, manufactured by the Berger Manufacturing Co., Canton, Ohio. The sheets of steel were supported every 10 ft. by structural-steel frames, and temporary wooden supports were also provided to reduce the unsupported span to 5 ft. during construction. Even with these additional supports considerable difficulty was experienced in keeping the partitions in proper alignment. The cement mortar, composed of 1 part cement and 2 parts granite dust, was applied by means of the cement-gun. This method, although producing a dense, hard wall, increased the difficulty in screeding and troweling the surface to requisite smoothness. The upper edge was made square by shooting the mortar against a piece of lagging laid along the top of the steel sheets. The chief difficulty in manipulating the cement-gun was to secure a uniform thickness of wall and uniform width of slots at the bottom of the V-shaped troughs. The cement mortar, as shot from the nozzle, accumulated rapidly on the steel, both on the ribs and flat surfaces, so that it was difficult to obtain a wall having a plane surface. This latter effect was produced by screeding and troweling. It is a question whether hand-plastered work would have been as cheap or as durable; on the other hand, it would have been possible to obtain a better-finished surface. The lower edges could probably have been handled more easily if a light steel angle had been fastened to the edge of the steel sheets as a stiffener.

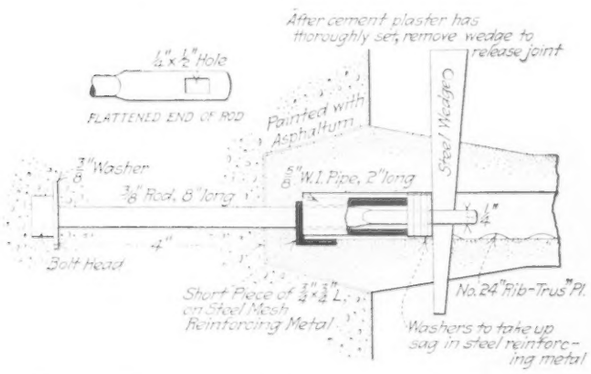

After cement plaster has thoroughly set, remove wedge to release joint
¼"x½" Hole
FLATTENED END OF ROD
Painted with Asphaltum
Steel Wedge
⅜" Washer
⅜" Rod, 8" long
⅝" W.I. Pipe, 2" long
¼"
4"
Bolt Head
Short Piece of ¾"x¾" L. on Steel Mesh Reinforcing Metal
No. 24 "Rib-Trus" Pl.
Washers to take up sag in steel reinforcing metal

Fig. 1. Expansion Joint between Trough and Walls of Imhoff Tank

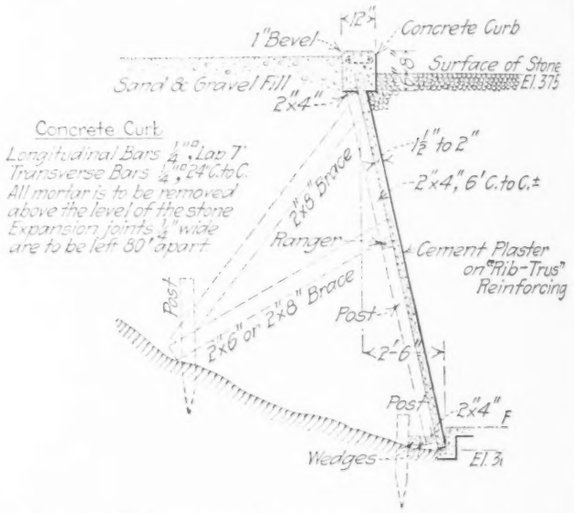


Fig. 2. Details of Retaining Wall for Sprinkling Filter

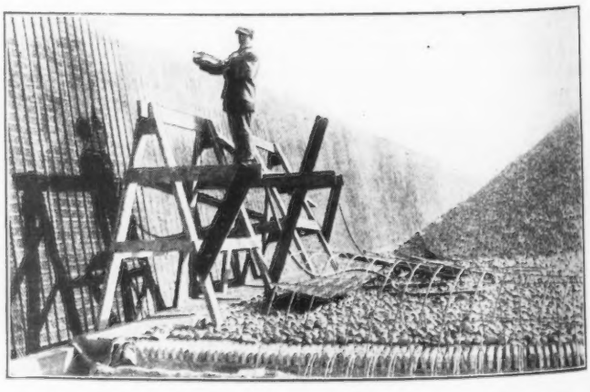


Fig. 3. Applying Cement Plaster to Wall of Sprinkling Filter

*Assistant Engineer with Metcalf & Eddy, Consulting Engineers, 14 Beacon St., Boston, Mass.

The special expansion joint and gas cutoff used between the thin partitions and the end walls of the Imhoff tanks, shown in section in Fig. 1, was very successful. This varies somewhat from the original design described in the article previously mentioned. This form of joint was designed to anchor the metal lath to the end walls during construction. A groove was built in the end walls along the line of the partition and in the center of this groove wrought-iron rods with flattened ends were embedded at intervals in the concrete. Short pieces of ¾x¾-in. steel angles were fastened to the edges of the rib-trus plates opposite each rod, to serve as lugs for anchoring the sheet-metal reinforcement. Tension was applied to the sheets by driving a taper pin or wedge into the hole in the flattened end of the rod, which caused the washers and pipe spacers to be wedged over against the steel angle lug fastened to the sheets. After the cement mortar in the thin walls had set, the pins were pulled out, leaving the partition walls free to contract without cracking. In nearly every instance these joints have opened up and but few cracks occurred in the thin walls themselves. The thin walls are 90 ft. long, with permanent supports every 10 ft.

The same type of thin-wall construction was used for the outside walls in the sprinkling filters (see Figs. 2 and 3), and the results are very satisfactory. It was specified that the surface of the wall should be left rough and no trowel finish applied. This was done with the idea that sewage running down over the rough face of the wall would be purified to a greater extent than if the wall surface was smooth. The earth backfilling on one side and the broken-stone filtering material on the other were placed at about the same time, and were carried up evenly on each side to prevent excessive pressures on the thin wall. The wall serves to keep sand and gravel from being washed into the broken stone, and with the earth backing acts as a retaining wall for the stone. For the conditions at Fitchburg, where the filters were constructed largely in excavation, this form of wall proved to be more economical than any other form considered. A concrete curb 12 in. wide and 14 in. deep was cast on the exposed edge of the thin wall to add a finish and make it more durable. The total cost of the sprinkling-filter wall, exclusive of earth backing, was approximately $3 per lin.ft., which for a height of 10 to 11 ft. is very low. The earth backing came from the filter excavation and cost practically nothing in addition, as embankment, to what it would have cost with the remainder of the excavation, which had to be placed in spoil banks some distance away. The cement-gun proved very advantageous to the contractor in this work on account of the extent of the plane surface to be plastered.

When bids were received for the construction of the sewage-treatment works four types of sprinkling-filter floor system were submitted to the contractors. These are illustrated in Fig. 4. The prices per square yard complete quoted by the R. H. Newell Co. and N. S. Brock, to whom the contract was awarded, were as follows: Type A, $2.90; Type B, $3.20; Type C, $2.60; Type D, $3.20.

Type C was selected as being the cheapest and at the same time one of the most desirable. Before constructing the floor the contractors encountered a serious difficulty on account of the failure of a clay-goods concern to furnish the vitrified clay blocks required at the original price quoted, and accordingly a new design was brought out, which was substituted for Type C. This design (Fig. 4),

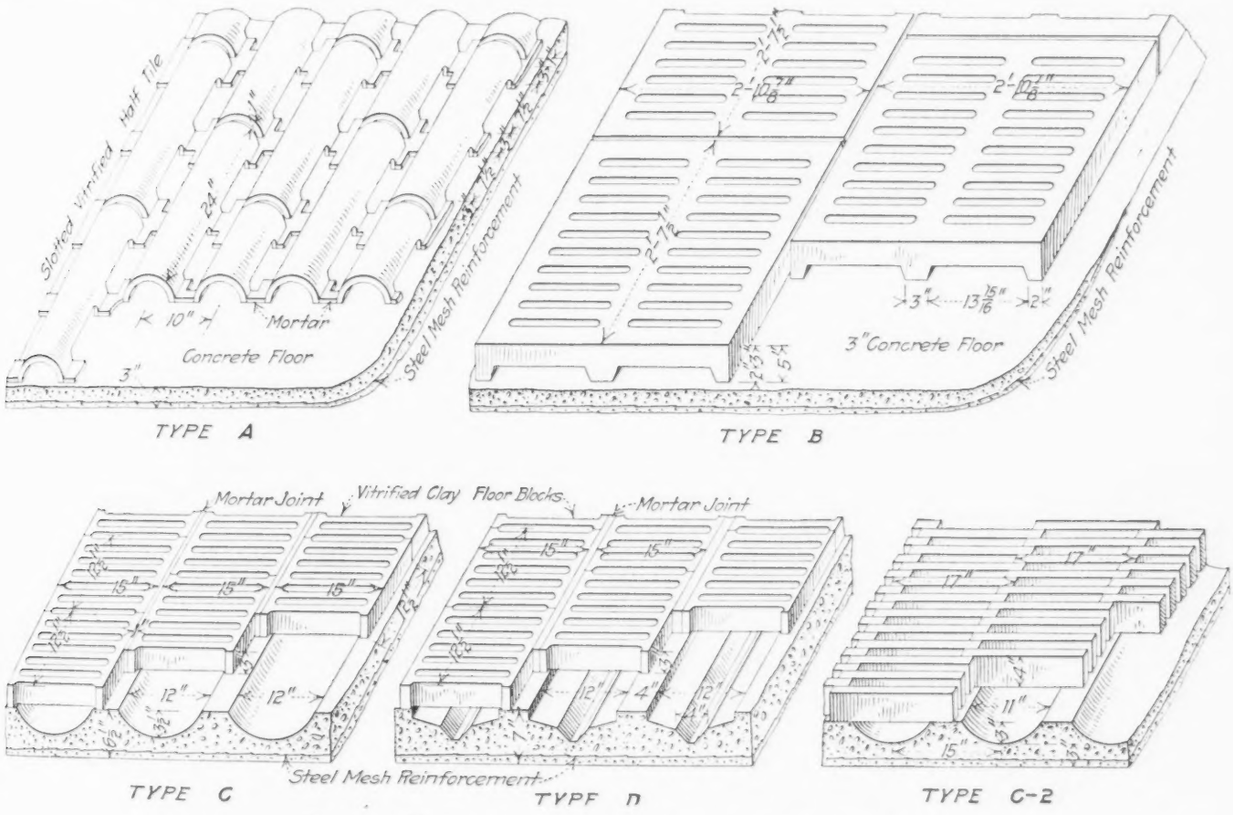


FIG. 4. TYPES OF SPRINKLING-FILTER FLOOR SYSTEM

(Bids were received on Types A to C. Type C was chosen, but, for reasons stated in the text, Type C-2 was used)

Type C-2, is similar to one of the alternate designs made by Metcalf & Eddy for Gloversville, N. Y. The small cement blocks, 17 in. long by 11⅝ in. thick and about 33¼ in. high, were constructed of cement mortar composed of 1 part cement and 2 parts granite dust, mixed to the consistency of thick cream and poured by hand in gang molds and then stored in tanks under water for about 24 days. The blocks were set in place (Figs. 4 and 5) in a thin bed of mortar. With this type of floor system 13% of the floor surface is drainage area. The flat floor offers a good surface for construction purposes, and the flow is confined in good channels, which can be readily flushed and cleaned.

The filter excavation was largely in coarse sand and gravel containing many small cobbles 2 to 3 in. in diameter. A layer of these was placed on top of the small concrete floor-beams to act as a guard against "splinters" of stone dropping down between the beams or into the floor channels. The same difficulty, although to a much less extent, was experienced with the remainder of the stone, which was trap rock brought in on cars. Especially in damp weather, fine dust adhered to the stone in spite of careful screening.

The broken stone for the filters was intended to be of such size as to be retained on a 1-in. ring and pass through a 2-in. ring. Some difficulty was experienced in keeping the size of stone within these limits. Apparently a sieve having 1-in. holes and operated carefully will retain some pieces of stone as small as ½ in. in maximum dimension, and similarly a sieve having 2-in. holes will not pass all of the stone having a maximum dimension less than 2 in. It would appear desirable to use screens having holes slightly larger than the ring sizes specified. About half of the stone used was a local granite obtained from Rollstone Hill.

Four 4-ton gasoline auto trucks were used to haul the stone a distance of about three miles from the quarry to the work. Although the roads were fairly good, the stone was shaken up considerably, resulting in grinding

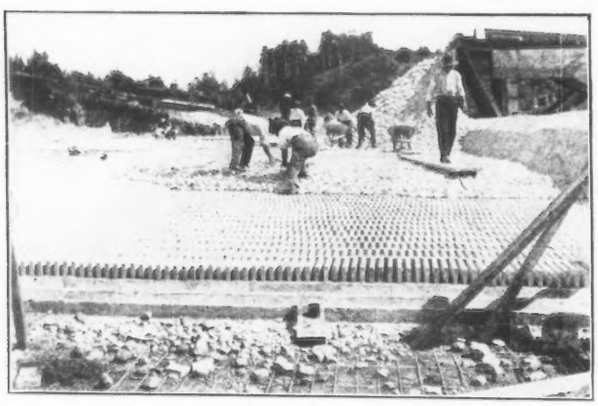


FIG. 5. CONSTRUCTING FLOOR SYSTEM AND PLACING COBBLES, SPRINKLING-FILTER FLOOR SYSTEM

and breaking, and it was found necessary to screen the stone again at the filter site to remove fine material thus produced as well as that escaping from the main screening plant. It is believed that better results would have been obtained if the stone had been both screened and thoroughly washed.

The distribution mains in the sprinkling filters, comprising 17 lines of 16- and 12-in. cast-iron bell-and-spigot pipe jointed with lead joints, were laid just below the surface of the stone, in order that the nozzles might be screwed directly into tapped holes in the mains and thereby obviate the necessity of using riser pipes. A special drilling machine was used for drilling and tapping these holes. The machine was fastened to the pipe by a chain passing around the pipe. The spindle carrying the drill and tap was set plumb by means of a machinist's

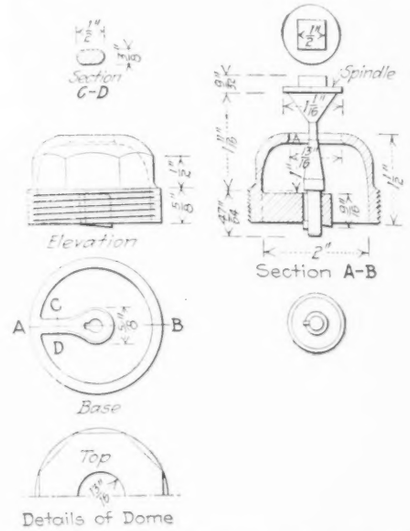


FIG. 6. DETAILS OF SPRINKLING-FILTER NOZZLE

level held against the vertical guide on which the spindle moved, and metal shims were used to adjust the machine to the required position.

The sprinkling filter nozzles used are a modified form of the nozzle developed at the Worcester sewage-treatment works. The general details of this nozzle are shown in Fig. 6. The patent rights in the nozzle are controlled by Matthew Gault, Superintendent of Sewers, Worcester, Mass.

The sewage-treatment works have been constructed under the supervision of David A. Hartwell, Chief Engineer, and Harrison P. Eddy, Consulting Engineer. The contractors were the R. H. Newell Co. and N. S. Brock. The Resident Engineer was Ernest E. Lothrop, to whom the writer is indebted for suggestions and photographs.

Philadelphia Street Cleaning by Contract

Philadelphia is one of the few large American cities where practically all the street-cleaning work is done by contract. To get this done efficiently by short-term agreements has required much study and many experiments on the part of William H. Connell, Chief of the Bureau of Highways; and the results are incorporated in the specifications for the current year, which contain many points worth noting. Abstracts of some of the more interesting clauses and those of value to city officials facing the same problem follow.

The contractor is not allowed to sublet his contract. He assumes responsibility for the use of patented materials or processes. He is liable for all damage done by his employees' acts. He is bound to observe all the city and state public health laws. City officials cannot be interested in the contracts.

Use of City Water

Water from the city low-pressure fire hydrants which have been specially marked for street-cleaning work, and generally are not less than one to a block, are used without charge only on permit issued by the Bureau of Water, and only for the purpose of executing the work designated in the specifications, the contractor being liable for any damage done to the hydrants by his employees. Failure to use a standard key in operating the hydrants, the use of leaking hose or hydrant connections, wasting the water, using unmarked hydrants, or other abuse of the privilege may result in the revocation of the permit. The city may revoke the permit when circumstances call for restriction in the use of water.

Annual Inspection

The specifications require that an annual inspection in the form of a parade shall be held during the year at a time designated by the Chief of the Bureau of Highways. The contractor is required to have his entire equipment and employees present, and any equipment or men absent from the inspection, or equipment or men present who do not conform to the requirements of the specifications, are subject to the deductions enumerated in the specifications. On the day of the inspection the men and equipment are relieved of their duties only for the time absolutely necessary, and on the completion of the inspection must continue their work for the full remainder of the day.

Reports by Contractor

The contractor makes daily reports to the Chief of the Bureau on approved forms, which indicate the number of men, machines and vehicles employed, the number of loads of dirt removed, the net weights of each, the number of sewer inlets cleaned each day and such other information as may be requested. The contractor also furnishes, in writing, such information in reference to the conduct of the work under his contract as may be required from time to time by the Chief of the Bureau of Highways. If such information is not supplied within two weeks from date of request for the same, the city may retain such payment as may be due the contractor until he has supplied the information requested.

The contract may be annulled at any time for failure to commence work when specified or to prosecute work to the satisfaction of the city officials. Failure to comply with any part of the specifications is cause for the city, after giving 24-hr. notice to the contractor, to employ sufficient force to have the work properly done and to pay for the same out of the fund deposited by the contractor as security. Payments are made monthly.

Qualifications of Employees

All employees must be thoroughly able-bodied and capable, both physically and mentally, of performing their duties to the satisfaction of the Chief of the Bureau of Highways. Any employee showing evidence of physical or mental incapacity is to be discharged upon the demand of the Chief of the Bureau, and is not to be re-employed except with the written consent of the Chief of the Bureau. All employees must be able to speak English satisfactorily. None but citizens of the United States are employed.

Any employee who neglects his duties, or uses improper language, or is under the influence of liquor while on duty, or accepts or demands pay from citizens for service rendered, or falsifies any report he may be called upon to make, is, upon demand of the Chief of the Bureau of Highways, to be at once discharged.

Each inspector, superintendent or foreman is required to wear while on duty a dark-gray uniform. All other employees must be provided at all times with uniforms approved by the Bureau of Highways. Uniforms are to be kept clean and must not be worn longer than one week without washing. Each employee must also wear at all times a badge on his hat or cap having thereon "D. P. W." in large letters and "Bureau of Highways" in small letters, also the number of the street-cleaning district, preceded by "Dist.," and a serial number. Each employee must also be provided with a suit of oilskin and other necessary articles to protect him while working during inclement weather.

Equipment

All sprinklers, cleaning machines, carts, wagons and other vehicles used in the prosecution of the work under the specifications must be painted in colors designated by the Chief of the Bureau of Highways, and all repainting during the life of the contract must be done in the same colors. All equipment is to be painted at least twice during the year with standard paints, specifications for which are on file in the office of the Bureau of Highways, and must be painted more frequently if these two paintings do not preserve the permanency of the distinguishing colors. The equipment must at all times be maintained in a cleanly condition, and the contractor is required to install adequate cleaning facilities within his stable or yard. Cleaning equipment in streets is not permitted.

Each kind of equipment is defined and described in detail, including squeegees, flushers, machine brooms, sprinklers, hand machine brooms and hand brooms. The contractor is required to keep all his equipment in repair and adjustment, subject to city inspection.

Classification of Street Cleaning

The city is divided into eight districts, and the kind and amount of street cleaning to be done in each are defined. A table is included in the contract giving the areas in each district to be cleaned every day, every two days, every three days and once a week. The day working hours are 7 a.m. to 12 m. and 1 p.m. to 6 p.m., and the night hours, 7:30 p.m. to 6 a.m. The work includes cleaning sidewalks of all waste paper and other refuse and in winter snow removal from the streets.

Liquidated Damages

The amounts of liquidated damages for each kind of neglect, or failure to comply with the specifications, are parts of the contract. There are 38 of these sums specified for various infringements of the contract specifications, and these vary from $25 a day for neglect to make daily reports to 50c. a day for failure of employees to wear badges and the prescribed uniform in a cleanly condition. For instance, failure to provide machine brooms with dust guards entails a loss to the contractor of $1 a day for each machine so operated. For cleaning streets without sprinkling (unless so authorized) $1 per square or part of square so cleaned is charged against the contractor. For not properly loading street dirt into wagons or carts or spilling the dirt 50c. is charged for each offense. These are random illustrations.

Two Large Irrigation Projects in Russia

By Milan Nikolitch*, Assoc. M. Am. Soc. C. E.

SYNOPSIS—Immense areas of dry land are being brought under irrigation by the Russian Government. Of two projects to be described, that on the Golodnaya Steppe, in Turkestan, reclaims for the present some 125,000 acres, while the one on the Mugan Steppe, which borders the Caspian Sea, reclaims 465,000 acres. The Golodnaya Project, here described, is a relatively simple one, consisting of head-gates, 32.6 miles of main canals, 110 miles of distributary and main-drainage canals and 780 miles of laterals and secondary-drainage canals. The Mugan Steppe Project, which will be described in a later issue, is more complex, comprising four independent canal systems.

Within the limits of the Russian Empire, stretching from the 17th to the 191st meridian and from the 35th to the 78th parallel, there is a great variety of climates. Speaking broadly, the average yearly rainfall varies between 16 and 28 in., with the exception of the western provinces of European Russia, where the rainfall rises above, and Caucasia and Turkestan, where it drops below that figure.

The greater part of southwestern European Russia belongs to the zone where agriculture is partly dependent upon irrigation. Turkestan and the eastern part of Transcaucasia are representatives of arid lands in the true sense of the word and require complete irrigation for existence.

It is very probable that in old times a certain portion of now desert lands in Turkestan and Caucasia were irrigated, but there are no means of judging of their magnitude. The most prosperous provinces of Turkestan, like Samarkand, Tashkent and Fergana, have been irrigated from time immemorial and are still supplied with water by primitive native canals. The water-supply for irrigation in Turkestan is mostly derived from small mountain rivers at their emergence upon the plains. Although the small rivers are almost used up, the large ones are scarcely touched.

It is certain that there is more land in Turkestan than can be supplied with water. The six great rivers of Turkestan and Transcaucasia—Illi, Choo, Sir-Daria, Amu-Daria, Arrax and Kura—have a total annual runoff of about 93,000,000 acre-ft., which can all be used for irrigation. Altogether the water-supply of Turkestan is sufficient for many millions of acres.

With the exception of native works, the art of irrigation is quite new in Russia and almost entirely confined to government enterprises. It might be safely said that there is not a single private enterprise of importance. The first large irrigation project in Russia was the irrigation of the Imperial Domains on the Murgab River, described in Engineering News, of Apr. 4, 1912.

The two irrigation projects here described are, so to say, pioneer projects and do in no way represent the standard work of the Russian Reclamation Service. They were begun with small means, and could be seriously attended to only in the last two or three years. The systematic work of the Reclamation Service was begun only a few years ago, but it has already developed to great proportions, promising to give excellent results. At the head of the Reclamation Service are Prince V. Masalsky and S. P. Maximoff, M. Am. Soc. C. E.

What is known as the Golodnaya Steppe occupies the country inclosed between the Sir-Daria River, the Turkestan Mountain range and the Kizil Kum Desert. It is situated between the 40th and 41st parallels and has an average altitude of 927 ft. above sea level. The total area of this country is about 1,900,000 acres, but not all of it can be irrigated. With the completion of the northeastern Golodnaya Steppe irrigation project, about 218,700 acres will be reclaimed. Surveys and designs for the other portions of the steppe are under way, and in

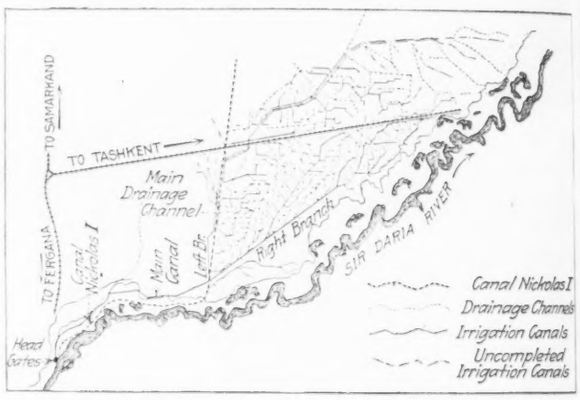


Fig. 1. Map of Golodnaya Steppe Irrigation Project, Russia

the near future a great portion of the former arid waste will be brought under irrigation. The situation of the Golodnaya Steppe between the rich provinces of Tashkent, Samarkand and Fergana, with which it is tied by railroad lines, together with rich soil and favorable climatic conditions, guarantees the success of the enterprise.

The climate of the Golodnaya Steppe is continental and is characterized by extremes. The summers are long and hot; the winters are sometimes very cold. The temperature reaches as high as 108° F. in the shade and as low as —20° F. The maximum mean monthly temperature for a period of seven years was 83° F., while the minimum was 19.2° F. Low temperatures last but a short time. The summer heat, on the contrary, extends over a long period of the year. An average for seven years shows that the number of days without frost in the Golodnaya Steppe is 209.

The precipitation is comparatively small, and the greatest portion of it occurs in the winter. The average rainfall for five years was 12.3 in., but for a longer period of observation it would probably be less. Of this

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amount only 0.55 in. fell during June, July, August and September.

The low rainfall, the great dryness of the air and the fact that the dry period of the year coincides with high temperatures make irrigation a necessity. For only a short time during the early spring the steppe is covered with luxuriant vegetation, but in May the sun and the lack of moisture turn it into a desert-like area, fully justifying its name, the Steppe of Hunger.

The water-supply for the Golodnaya Steppe is diverted from the Sir-Daria River, the only stream which can insure a supply to a large area. Sir-Daria rises in the mountains of the Central Tian-shan, where its two branches are known as Narin and Kara-Daria. Both are torrential in character in their upper courses. After leaving the mountains, each river runs through the province of Fergana, where a great portion of the Kara-Daria is used for irrigation by the native works. The Sir-Daria, made up by the junction of the Narin and the Kara-Daria, flows for some distance through Fergana, and after passing the mountain Mogol Tau, enters the great central Asiatic plain, through which it runs for about 810 miles to the Aral Sea. The total length of the river is about 1430 miles.

The Sir-Daria owes its waters to the melting of snow in the high mountains. Its high-water period occurs in summer, when mostly needed for irrigation.

The discharge of the river has been regularly observed since 1903. In the following table are given mean annual discharges of the Sir-Daria for a period of eight years, according to the reports of the Turkestan hydrometric service:

ANNUAL DISCHARGES OF SIR-DARIA RIVER FROM 1903 TO 1910

(Gaged at the head of the main canal)

Year	Discharge, Sec.-Ft.	Year	Discharge, Sec.-Ft.
1903	27,000	1907	22,400
1904	22,400	1908	33,500
1905	22,500	1909	22,400
1906	17,100	1910	23,000

The maximum discharge occurs in May and June and the minimum in January. During the period 1903-1910 a maximum of 109,000 sec.-ft. has been observed, while during the same time the minimum was 6860 sec.-ft.

HISTORY—The art of irrigation has been practiced in Turkestan from very early times. Large areas that are now abandoned and desert-like have been reclaimed in the past. Still, the Golodnaya Steppe does not seem to have been irrigated to a large extent, although, judging by existing legends, attempts to that end were not lacking. The fact that the river lies some 50 ft. below the floor of the Golodnaya Steppe made it difficult for native engineers to bring the water to the steppe, and all attempts resulted in a few small canals, their remains still being traced in the steppe. Only the lowland along the river and the area near the mouth of cañons of the small mountain rivers were irrigated to some extent.

With the Russian occupation of the country the idea of reclaiming the Golodnaya Steppe by the water of the Sir-Daria was renewed. During the last 10 years several attempts have been made, but owing to various unfortunate circumstances, most of them proved failures. Only the Canal Emperor Nicholas I was successfully completed. It irrigates an area of about 32,400 acres.

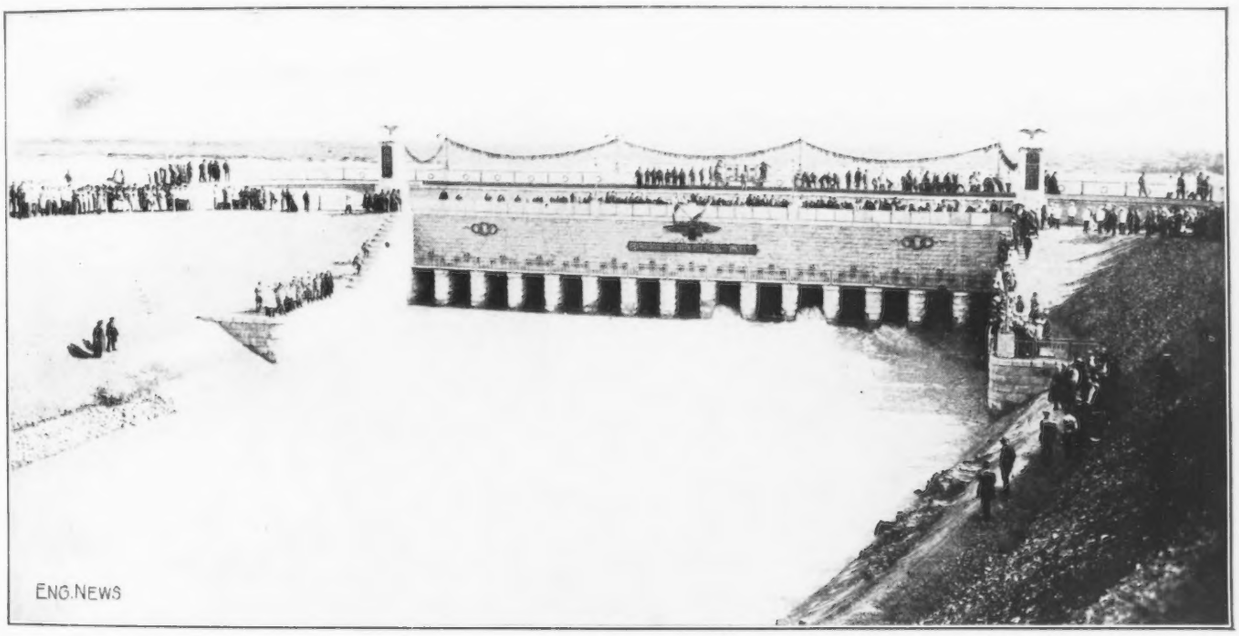


FIG. 2. VIEW OF HEAD-GATES OF GOLODNAYA IRRIGATION PROJECT

(The structure was officially opened on Oct. 5, 1913, in the presence of many state officials)

The first steps toward irrigating large areas of the Golodnaya Steppe by the government date back to 1895, when the first well-organized parties were sent there. The actual work of construction of the Northeastern Golodnaya Steppe project began in 1901, and was prosecuted slowly on account of lack of funds until 1911, when the first large appropriation was made and the work vigorously resumed. By the end of 1913 most of the work was completed. The area thus brought under cultivation is 121,500 acres, not counting 32,400 acres, dominated by the Canal Nicholas I, which is to be incorporated into this system.

GENERAL FEATURES OF THE PROJECT—Generally speaking, the project (see map, Fig. 1) comprises head-

gates, a main canal 23.6 miles long, distributaries and main drainage canals 110 miles long, laterals and secondary drainage channels about 870 miles long, regulators, outlets, bridges, etc.—altogether 540 structures.

During the construction about 17,500,000 cu.yd. of earth had to be moved, of which 46% was from the main canal. The total area covered by the canal is about 218,700 acres, but only some 125,000 acres is supposed to be actually irrigated at one time. The cost of the works is estimated to be $3,660,000, or a unit cost of $29.28 per acre of irrigated land.

Head-Works—No dam is provided, and in order to assure the full supply to the canal during the lowest water stand in the river, even when other irrigation projects along the upper course of the Sir-Daria are realized, the sill of the intake gates is placed at about the bottom elevation of the river. This has resulted in a maximum head against the gates of about 21.7 ft.

The head-gates (Fig. 2) are similar to those used on irrigation canals in India. They consist of 15 openings, 6.3x10.50 ft., separated by masonry piers 28.70 ft. high and 3.50 ft. thick. The piers rest upon a heavy concrete foundation 8.75 ft. thick, which is faced by granite blocks 1.05 to 1.75 ft. thick. The entrance to the canal is regulated by steel gates raised by a traveling winch from the working platform. A row of stop logs, placed in the front of the gates, is provided to prevent the débris, carried on the bottom of the river, from entering the canal, and to help in obtaining relatively clear water from the surface. To reduce the effect of the falling water upon the floor, provision is made for another row of stop logs in the rear part of the piers, by means of which a kind of water cushion is created. For a distance of 2450 ft. below the head-gates the bottom and the slopes of the canal are protected by rubble masonry, concrete and riprap. The cost of the structure was $288,000.

The Main Canal—The floor of the Golodnaya Steppe below the head-gates is about 56 ft. higher than the alluvial lowland along the river. The length of the main canal from the head-gates to the point where it emerges upon the steppe and is divided into two main distributaries is about 23 miles.

The first part of the canal is made in conglomerate and gravel, after which the canal runs through the lowland area, mostly in cut, also in combined cut-and-fill section. Toward the end the canal extends through several deep cuts, of which the deepest is about 53 ft.

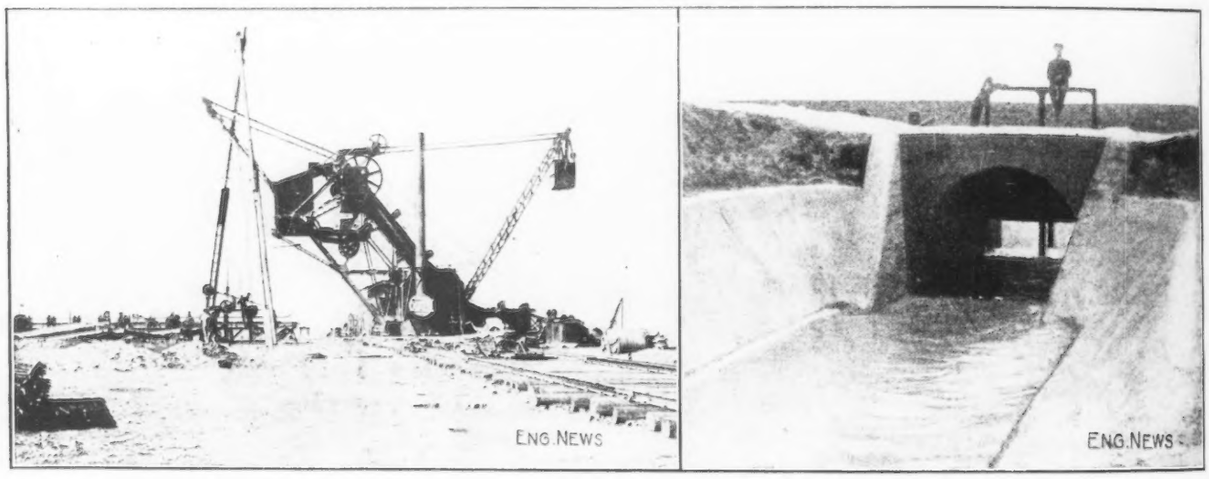
The dimensions of the main canal have been designed according to the material in which the canal is located. The bottom width varies from 56.70 to 98 ft. The depth ranges from 5.25 to 9.45 ft. The adopted grade is rather higher than is commonly used for canals of this size, varying from 0.0001 to 0.0007. The discharging capacity of the canal is said to be not less than 1715 sec.-ft. Where the canal is made in cut it is given side slopes of 1½:1 and in deep cuts above the water surface ¼:1. Embankments are made with side slopes of 2:1 and have a top width of 21 ft.

The total earthwork, in amount of 8,130,000 cu.yd., cost $1,215,000. About 266,000 cu.yd. of excavation in gravel and conglomerate at the head of the canal has been done with a steam shovel. For the remaining part hand labor has been used exclusively.

The Distributary System—At the 23d mile the main canal is divided into two branches, which are practically two main canals. The Right Branch was completed early last year (May 16, 1914), while the other branch is only partly completed with a view to future extensions. The topography of the country allowed of so locating the canals as to enable them to supply the water to laterals on either side.

The Right Branch is designed to have a capacity of 600 sec.-ft.; the Left Branch, of 1294 sec.-ft. The Right Branch has a length of 29.3 miles, besides two main laterals, while the Left Branch is 33.3 miles long. The cross-section of both branches is so designed that the water is mostly above the surface of the surrounding country. Of 3,660,000 cu.yd. moved from the canal cross-section and borrow-pits, about 2,950,000 cu.yd. were used in embankments. The top width of the embankments is from 10.50 to 17.50 ft. and the side slopes are 2:1. The grades vary from 0.0001 to 0.0005.

The water surface in the canal being well above the ground surface, special care was exercised to obtain tight embankments by thorough wetting and tamping. A special feature of building embankments on several canal sections was to provide, by means of low embankments, basins of the required width and to dump earth into



Figs. 3 and 4. Views on Golodnaya Steppe Irrigation Project, Russia
(Fig. 3 (left)—The Lübeck excavator. Fig. 4 (right)—A regulator at the head of a distributing canal)

them and allow it to settle under water, after which the water was drained off. The embankments obtained in this way are said to be more satisfactory than those made by common methods of wetting and tamping.

So far the lateral system is built to deliver water to units of 370 acres, but as the land is to be sold in units of 8 to 10 dessetins, or about 21.60 to 27 acres, it is very probable that the government is going to construct the lateral system to suit this subdivision, leaving only the farmers' ditches to private initiative.

The lateral outlets are of concrete or reinforced concrete, controlled by steel gates. With the completion of the system there will be about 292 miles of laterals and 510 outlets.

During the construction of the distributary system both hand and machine work were used. Three excavators of the type shown by the view, Fig. 3, were installed, and gave fairly good results.

Drainage System—The small slope of the country, the proximity of ground water, the presence of alkali and the possibility of increasing it with the use of irrigation, but especially the aim to improve the alkali soil by thorough drainage, have imposed the necessity of designing and building a complete drainage system at the same time as the irrigation system.

The main drainage channel is excavated in the valley between the Right and Left Branches. It is 35.8 miles long and has a discharge of 515 sec.-ft. With a small exception the entire irrigated area drains into it. The total length of drainage canals and ditches amounts to about 537 miles. The object of the drainage system is not only to take care of the surplus water in the soil, but also of one part of the surface water, which is going to be wasted through the main collector into the river.

Structures—With the exception of the head-gates, there are no structures of special interest. (See Fig. 2 for head-gates and Fig. 4 for a minor head-gate or regulator at the head of a small canal.) For building material, concrete and reinforced concrete were used for permanent bridges, regulators and outlets. Concrete and rubble masonry were used in substructures of steel bridges under railroad tracks; common and adobe brick for buildings, and wood for temporary bridges.

Future Extensions—By the project just completed, only the northeastern part of the Golodnaya Steppe is irrigated; but simultaneously with the construction other large areas of the steppe have been surveyed, and at the time of writing the designs are being prepared. In the near future there will be about 1,323,000 acres of irrigated land in this part of Turkestan. Of the total acreage it is estimated that 594,000 acres are in the northern part of Golodnaya Steppe; 648,000 acres in its southern part, and about 81,000 acres are situated on the right bank of the Sir-Daria, which is also called the Dalverzin Steppe.

For this great undertaking some change must be made in the adopted type of the head-works, which are not designed to meet the requirements of a large project. Very probably a dam will be built across the river at or above the present head-gates. By means of the dam, water can be taken direct to the floor of the Golodnaya Steppe. The drop thus created in the canal can be utilized for generating power, which again can be used for pumping.

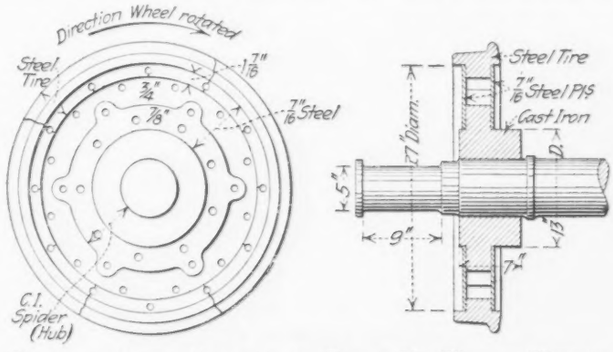
The construction of the project has been made under the chief engineer, F. Tolmacheff, and the assistant chief engineer, A. Kursish, to whom the author is indebted for many data. The contractor was S. N. Chaeff.

[*The Mugan Steppe Project will be described later.*]

Built-Up Car Wheels Declared Inadequate

Steel-railway-car wheels built up with a cast hub, rolled tire and thin cheek plates have been declared of insufficient strength for present requirements. This statement is made by H. W. Belknap, Chief of the Division of Safety, and J. E. Howard, Engineer-Physicist, Interstate Commerce Commission, as the result of investigations following the derailment of a passenger train, caused by a broken wheel, on the Chicago, Milwaukee & St. Paul Ry., at Oakwood, Wis., on Jan. 30, 1915.

After this accident the tire of the wheel causing the trouble was found broken in four pieces, three of which were recovered in 850 ft. back along the track. The remaining piece has not been found. The construction of



Elevation and Section of Built-Up Wheel Which Failed at Oakwood, Wis.

the broken wheel was as shown in the accompanying sketch. Besides the four radial fractures, which all passed through bolt holes, the tire web was cracked from each bolt hole to the inner circumference. The broken pieces of tire assumed a radius of curvature slightly less than when intact, indicating internal stresses. Lack of rigidity and of unity of action in the built-up wheel were shown by brightened plate metal around the outer bolt holes and by shoulders where the inner edge of the tire web bore. The mate to the broken wheel (on the same axle) was found to have incipient cracks at each bolt hole of the tire, though otherwise intact. The total travel of the broken wheel was 276,400 mi., corresponding to 170 million revolutions. The loads ranged from 9375 to 11,250 lb.

Twenty similar wheels which had been removed (for cause) from service were examined, and half were found defective, 56 incipient cracks being seen in the interior of the webs and 19 full fractures. All the tires examined showed internal stress, due to cold rolling in service. One tire through which a radial cut, 2 in. wide, was made sprung together $\frac{15}{16}$ in.

The presence of incipient fractures cannot be detected by hammer test or external inspection—only by partial dismantling of a wheel. The critical places in the construction are hidden by plates and bolts. While wheels of this type are reported as not being used as much as formerly, the investigators recommend inspection of the metal at bolt holes as a safety measure.

The Federal Railway-Valuation Work*

By George H. Burgess†

In the Federal valuation work now under way the Interstate Commerce Commission and the railways of this country are engaged upon an undertaking of great magnitude, and one for which there have been no well-established precedents in this or any other country.

The first state valuation of railways was made in Texas in 1894 for the regulation of security issues. This work was taken up in Michigan in 1900 and in Wisconsin in 1903 for taxation purposes, and in Minnesota in 1907 in connection with revision of rates. Valuations have also been made in Washington, New Jersey, South Dakota, Nebraska, Kansas, Oklahoma and California for various purposes.

The trend toward a Federal valuation of all railroad properties in the United States began with recommendations in the early reports of the Interstate Commerce Commission that such work be undertaken. In 1900 the Interstate Commerce Commission made an investigation of the value of all railroad properties as indicated by market prices of securities, and expanded this work in coöperation with the Census Office in 1904. President Roosevelt in March, 1906, wrote to the Interstate Commerce Commission stating that it seemed to him to be desirable to have a valuation made, and in December, 1906, and again in December, 1907, Senator La Follette introduced bills providing for such a valuation. The final bill which has resulted in this work being undertaken was approved by the President Mar. 1, 1913. There is nothing in the act which specifies the purpose for which this valuation is to be made. The results may be used for any of the following purposes: Taxation, rate-making, control of security issues and state ownership.

The provisions of the act require the ascertainment of the original cost to date, the cost of reproduction new, the amount of depreciation, and other values and elements of value. It also provides for investigation into the financial and corporate histories of the properties and a study of the amount and nature of public aid given in connection with the construction of railroads. The act provides that after the commission has made its investigation and has arrived at a determination of the value of any property, public notice of the same shall be given, and the carrier is allowed 30 days to either accept or appeal from the findings of the commission. It is this provision that makes it so necessary for the carriers to have their own organizations to follow closely the work of the commission's employees, so as to be prepared when the valuation is announced to either accept or reject it.

The Government organization for this work consists of a director of valuation assisted by an advisory board and an attorney, an engineering board, an accounting board, and a land board, as well as a number of men for special purposes; as, for instance, a cost-data bureau has recently been established to make a study as to unit prices to be applied to construction quantities. Charles A. Prouty, who was a member of the Interstate Commerce Commission at the time of the passage of the Valuation Act, is director of valuation. The country has been divided into five districts, each containing about 50,000 mi. of railroad. These districts are known as the Eastern, Southern, Central, Western, and Pacific. The engineering board consists of five members, each member having charge of one of the districts.

Each member of the engineering board is assisted by a district engineer, who is in charge of all the field organizations for his district.

All the members of the engineering board and the district engineers have had considerable experience in railroad work. Of these ten men, nine are members of the American Society of Civil Engineers. The organization for each district consists of a number of engineers having varied duties. There is an assistant district engineer, civil, structural, signal, mechanical, electrical, bridge, roadway and track, field, and office engineers, architects, inspectors of motive power and car equipment, and numerous engineers filling positions in the field parties.

Parties have been sent out on several railroads in each district to make the actual field surveys and field inventory. A field party generally consists of ten men divided into squads or groups, some of which do cross-sectioning, others chaining, and others miscellaneous field and computation work. All of the engineers employed in this work, with the exception of the members of the engineering board and the district engineers, have been selected through the Civil Service Commission at Washington. Many of the higher rated engineers have been selected by the Civil Service Commission, not by means of examination but through selection based on study of a man's record as submitted by himself and as given by references to whom he may have referred the commission in connection with his application. For the junior positions, regular written examinations have been submitted, and the result of such examination, together with a man's record as to education and experience and recommendations by his references, has established a basis for selection.

So far as the work has been undertaken by the Government in the field, it has been to make a very careful and minute survey of all physical property. This involves cross-sectioning of the entire road and careful compilation of quantities of cuts and fills and the classification of materials. All bridges and buildings are measured; all tracks and various units that go to make up the track, such as weight of rail, number of ties, frogs and switches, spikes, fastenings of all kinds, and depth and character of ballast, are noted, and proper allowance is made in compilation of quantities in connection with each item. No attempt has thus been made to establish uniform prices to apply to the units found by the field survey. This is probably a question that will require careful consideration and conference between the Government engineers and the carriers. The Government has, as before stated, established a bureau, the sole duty of which is to investigate unit costs, and this work is in the hands of men who are undoubtedly well suited to handle this question.

Survey parties were placed in the field by the Government in 1914, and work has been in progress on about 16 different lines. Field work has been practically completed on six railways, about 3800 mi. of line.

*From a paper presented before the Binghamton Engineering Society.

†Chairman of Valuation Committee, Delaware & Hudson Co., Albany, N. Y.

Cost of the Work

When it was first suggested that a valuation should be undertaken of all the railroads in the United States, Professor Adams, statistician of the Interstate Commerce Commission, stated his belief that the work could be done at about the same cost as the work that was completed in Michigan at about that time, about $5 per mile or $1,250,000 for the whole country, and that the cost to the railroads would probably be as much more. The costs of all state appraisals had been not to exceed $10 per mile, and in Texas as low as $2 per mile, indicating a very incomplete method of doing the work. In 1912 Interstate Commerce Commissioner Clements stated that the cost would probably approximate $3,000,000 and the length of time to do the work would be three years, although he afterward stated that the cost might run up to $5,000,000 and the time to five years. Interstate Commerce Commissioner Meyer at about the same time stated that the cost would probably be as high as $5,000,000 for the Government and that it would cost the railroads as much more and take four years to complete the work. Railroad officials who appeared before the Senate committee at hearings on the bill which was finally passed also greatly underestimated the cost, as they stated that the work would cost the railroad companies and the Government each about $3,000,000.

In August, 1913, after the passage of the act and when the plans were fairly well formulated as to the method of handling the work, the Interstate Commerce Commission estimated that the Government expenditure would be from $10,000,000 to $15,000,000 and that the work would take about seven years to complete. A year and a half after the passage of the act Director Prouty in his speech before the National Association of Railway Commissioners on Nov. 17, 1914, stated that the expense to the Government would be about $16,000,000 for obtaining cost of reproduction and for the accounting work and that it was likely the cost to the railroads would be from $25,000,000 to $35,000,000, which would mean a total cost of nearly $50,000,000—quite a different estimate from that made at the time of the passage of the act. As to the length of time that it will take to do this work, two years have elapsed since the passage of the act, and up to about the first of January field work has been completed on about 11,000 mi. Allowing a year to get the work under way, it is safe to state that 11,000 mi. has been completed in one year. Director Prouty has stated that sufficient parties should be in the field by July 1, 1915, to complete 4000 mi. per month, or 48,000 per year, which would mean that from July 1, 1915, it will take practically five years to complete the work. This estimate is based on past results, generally on smaller roads, and it is probable that work cannot proceed so rapidly on the larger systems, so that it seems probable that this time limit may be exceeded.

Valuation Organization by the Railways

On the passage of the Valuation Act it became necessary for the railroad companies to establish an organization which would enable them to keep in touch with the progress of the work and provide the required coöperation with the Government. Practically all the railroad companies in the country joined in the formation of what is known as the President's Conference Committee. This committee consists of 18 railroad presidents under the general chairmanship of Samual Rea, president of the Pennsylvania Railroad. This conference committee is divided into three groups—Eastern, Western and Southern—with a chairman for each group.

At the group headquarters there is an engineer reporting to the chairman. There are a number of attorneys attached to the various groups, whose duty it is to consider the legal aspects of the problems confronting them in connection with the work. There have also been formed an engineering committee of 13, an equipment committee of 5, a land committee of 15, and a financial, history, and accounting committee of 13. These committees report to the Presidents' Conference Committee and take under consideration the various questions for which decision is desired by the carriers as to methods of procedure and uniformity of action; and at the same time these committees meet with the various Government boards of similar character to discuss questions which may arise.

Practicaliy all the railroad companies have organized valuation committees, made up of officials of the company, generally composed of representatives of the engineering, motive-power, land, accounting, and legal departments, and in addition a special organization has been formed to carry on the actual preparation of necessary information. The Delaware & Hudson Co. established an organization about Nov. 1, 1913. In addition to the preparation of required maps and profiles, we have made a careful study of the construction history of the road to obtain dates as to the building of the various parts of the system.

One of the most important features of our present work is the study of our records for hidden or obscure items of cost. It is obvious that a field inspection of a property, even with careful measurements taken of all visible features of construction, will not be the true measure of quantities comprised in the property nor give us the true cost or value. For instance, fills have been made on soft ground requiring many yards of earth which cannot be measured, difficult and expensive foundations have been placed under structures which do not show up now, streams and highways have been changed, and innumerable difficulties have been encountered involving heavy expenditures which cannot be determined on the ground.

Our search of the records discloses many of these items in such a way as to be readily verified, also the recollection of older employees and residents along the line gives us information of importance. All these data are collected in such form as to be properly presented to the Government engineers, and will no doubt be accepted.

It is necessary for the carriers to have representatives with the Government parties, who are called pilots, who are supposed to be thoroughly familiar with the property. These pilots will be intrusted with the duty of seeing to it that all visible property of the railroad is measured or noted. Also they must call attention to the hidden and obscure quantities where known to exist, and generally assist the Government party in making an accurate survey of the entire property. The careful training of the pilots is essential, and the men who are now working up the preliminary information will later be used by the carriers as their pilots.

The Delaware & Hudson Co.'s lines are made up of 11 different active corporations, while the total number of

corporations that have been organized during the history of the company is 17.

The first railroad track built on the Delaware & Hudson was completed and put in operation in 1829 between Carbondale and Honesdale. This consisted of hemlock stringers with iron strap rail to reduce wear. The motive power was gravity and horses. The first locomotive engine that ever ran on rails in this country was the "Stourbridge Lion," which ran a trial trip over a part of this track on Aug. 8, 1829. While the success of this means of locomotion was assured by this experimental trip, the locomotive was not used in regular traffic, it being found that the track and trestles supporting it over streams were not of sufficient strength to carry it.

The first line which now makes up the Delaware & Hudson system on which steam power was used regularly is that between Saratoga and Schenectady, which was built in 1832 from Schenectady to Ballston and completed in 1833 to Saratoga. In 1835 the line from Troy to Ballston was built and in 1850 was completed through to Whitehall. The line along Lake Champlain to the Canada line was built in the '70's and completed in 1876. The line between Albany and Binghamton was completed in 1869, having been under construction for about ten years. About 87% of the Delaware & Hudson system was built prior to 1880, so that it becomes rather difficult to get satisfactory records of construction carried on more than 30 years ago.

It is of the utmost importance that all quantities should be carefully measured and every possible allowance made to the railroad companies for the full amount of tangible property.

New Chittenden Plant of the Pittsford Power Co.

By Thomas Fraher*

SYNOPSIS—The highest-head plant in the East develops 3700 hp. from water flowing between two reservoirs and previously unutilized. A notable feature is a 2¼-mile length of Oregon fir pipe. Some interesting notes on construction methods for a small plant are appended.

The recently completed hydro-electric development of the Pittsford Power Co. in Chittenden, Vt., 7 mi. north of Rutland, is of unusual interest, since it has the highest head in the East and a long wood-stave penstock built mostly of Oregon fir. A short run of pipe made from local spruce allows comparison of two materials and shows the advantages of the Western lumber.

The plant utilizes storage water from an existing reservoir, the flow from which to a lower reservoir formerly performed no useful work. This reservoir impounded about 800,000,000 cu.ft., which the additional runoff increased to about 1,000,000,000 cu.ft. of water available in an average year. The static head from the top of the flashboards to the weir in the tailrace is 481 ft. Two 1850-hp. units are installed at present, and provision has been made for a third similar unit.

Features of Design

Wood-Stave Pipe—Fig. 2 shows the alignment of the pipe line. Starting at the dam, it is of native spruce for a distance of about 1400 ft., and then of Oregon fir for 12,000 ft. farther, except at a point around a rocky knoll, where the curvature was too short for wood-stave pipe and it was found necessary to insert a steel bend. The gradient to the end of the wood-stave pipe is uniform at 0.3%, but from here the line drops abruptly to the power house through a steel penstock about 2800 ft. long. The spruce staves were made from lumber cut in the adjacent territory and air-dried for nine months. They were then milled to a finished thickness of 2⅝ in. and averaged from 12 to 14 ft. long. The Oregon-fir staves were made from live Douglas fir and were milled to a finished thickness of 2⅛ in., the average lengths running about 20 ft. Thirty-six fir staves made a pipe section of 60 in. inside diameter. The pipe details may be summarized as follows:

Inside and outside of staves milled to true pipe circumference; edges beveled radially; ends butted square and given ⅛x⅛-in. saw cut for steel tongues; bands of openhearth steel, ⅝-in. diameter, one with both ends headed and one with rolled threads on each end, bent to pipe circumference and dipped in asphaltum paint before shipping; "noneccentric" malleable-iron dipped shoes; band spacing varied from 3 to 6½ in.; maximum head, 85 ft.

Connection was made between the existing 48-in. outlet valve of the reservoir and the 60-in. wooden penstock through a steel increaser with an 18-in. branch, upon which was placed a 24-in. steel vent pipe 55 ft. high, protected by a double casing of wood staves and electrically heated by a car heater.

Aqueducts—Fig. 2 shows four stream crossings. These were made on steel I-beams supported by 2x8-ft. concrete piers and rubble-stone abutments. The spans are shown in detail in Fig. 4. The distance of the cradles above the top of the flange varied according to their position, so that when the pipe was full the deflection of the beams would bring the staves to a straight line. Both cradles and staves on the trestles were creosoted.

Steel Penstock—At the end of the wood-pipe line is a steel nipple, to which is bolted a butterfly valve, to which in turn is bolted a tapered section, reducing the size from 60 to 54 in. The steel penstock then makes a combined horizontal and vertical curve and runs to the power house through various gradients from 2 to 65%. The steel-pipe data may be thus summarized:

Length of 54-in. lock-bar pipe, 600 ft.; length of 54-in. riveted pipe, 1100 ft.; length of 52-in. riveted pipe, 1050 ft.; thickness varies from 5/16 to 9/16 in. All circumferential seams single riveted; longitudinal seams triple riveted with double butt straps.

The steel penstock is anchored at the angles and there is a heavy reinforced-concrete anchor at the power house.

Surge Tank—Just below the butterfly valve a 48-in. steel-pipe connection is taken off to a surge tank 14 ft. in diameter by 90 ft. high. The top of this is 19 ft. above the flashboards on the dam. After the tank was tested a frost casing, 18 ft. in diameter, made of old 2-in. plank

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and covered with wire lath and cement plaster, was built around it. The tank is heated by a stove housed in a stone structure located at the foot of the 48-in. connection, from which point a smoke-pipe is run inside the casing and out through the roof at the top of the tank. The foundation for the tank is of concrete on solid rock, the six 2½-in. anchor bolts going into the rock.

Power Station—The generating station (see accompanying elevation) is a single-story brick structure 38x71 ft. inside and 22 ft. high. Just outside is located a venturi meter, from which the penstock enters the building, coming up through 24-in. nozzles into the turbines, which are supported directly overhead on 12-in. H-beams. The turbines are of the Francis type, rated at 1850 hp. for 720 r.p.m. and 130 ft. effective head at full gate. At the driving end of the shaft is a 4½-ton flywheel. Relief valves operated by the governor are installed on each turbine to protect the line against undue rise in pressure resulting from any sudden large variation in the load.

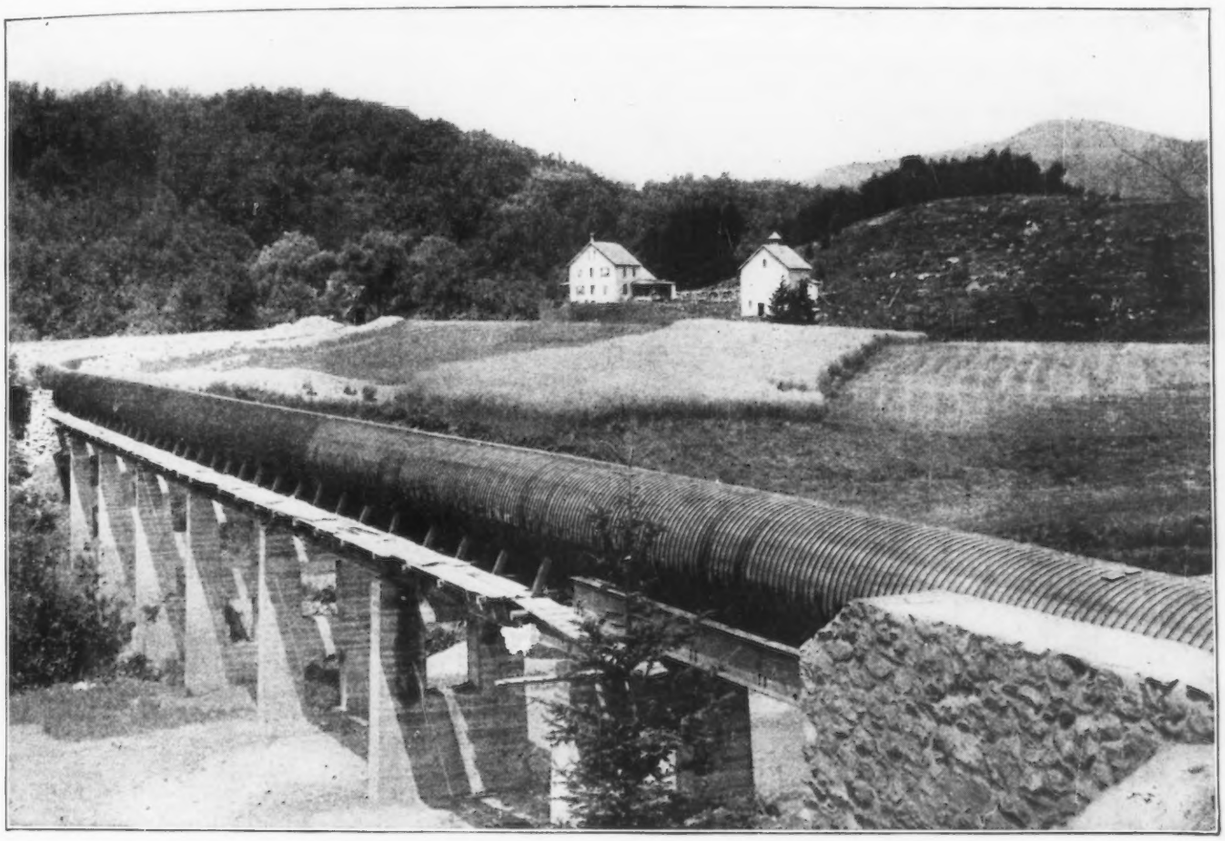


FIG. 1. WOOD-STAVE PIPE LINE AND VIADUCT, PITTSFORD, VT.

Each generator is a 2300-volt three-phase 60-cycle machine, rated at 1250 kv.-a., and has an overload capacity of 25% for two hours. Each has a direct-connected exciter. Each unit has a bank of transformers consisting of three single-phase 400-kv.-a. 2300-44,000-volt water-cooled units, taking water at reduced pressure from the penstocks. Cables under the floor lead through remote-control switches to a copper-tube bus. Each transformer bank is connected to the bus through disconnecting

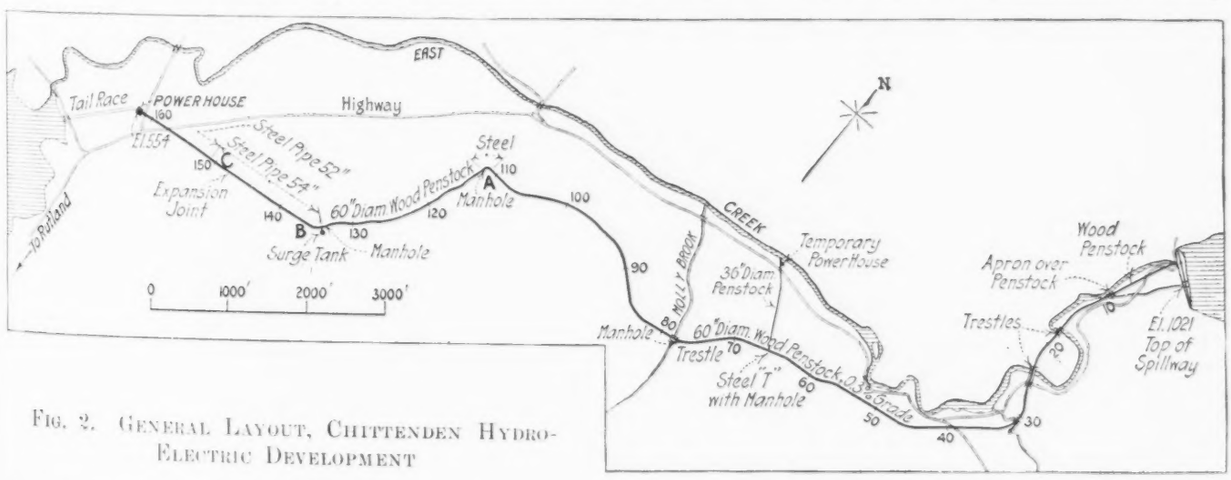


FIG. 2. GENERAL LAYOUT, CHITTENDEN HYDRO-ELECTRIC DEVELOPMENT

switches and to a 11,000-volt outside bus through roof bushings and outside air-break switches, which are hand-operated from the station floor. The high-tension bus, air-break switches and lightning-arrester horn gaps are mounted on pipe framework on the roof.

Construction Notes

Excavation—Excavation was started about Jan. 1, 1914, but on account of a contract to deliver power beginning July 1 it was decided that it would be necessary to build a temporary station at a point half way down the line

Fig. 3. Covered Surge Tank

where 200-ft. head could be obtained, and then finish the permanent station as soon afterward as possible. An office, storehouse and bunkhouses were first built near the temporary station site. A party ran out line and grade, set slope stakes, etc., for the pipe lines. About 50 men were started on excavation, and it was found that the snow blanket had prevented deep freezing. Most of the work was done by pick and shovel, with the assistance of plows and scrapers where they could be used to advantage. It was necessary, however, to uncover only as much ground as could be brought up to grade by nightfall. Most of the excavating was through ground filled with large boulders, some of which were dragged out to fills; but the largest were broken and removed by exploding a charge of powder in a pocket underneath. All fills were left until warm weather, although the culvert drains were laid.

By March an office, cement-shed, storehouse and bunkhouses had been built near the permanent station site and 75 men were started on the excavation for the steel penstock. The forces were increased with better weather, and numbered 300 in June. On the lower thousand feet of the wooden penstock and for the steel line much solid rock was encountered. This was drilled first with two hand air drills supplied by a 6-hp. portable gas-engine vertical-compressor outfit; later three drills were used with an 8x8-in. compressor, which at the start was driven by a gasoline engine and later by a 50-hp. electric motor.

Distributing Material—About Apr. 1 the different materials began to arrive in Rutland. The site is from 500 to 1000 ft. higher than the city and from 7 to 10 mi. distant. Except for about 2 mi. near the city, the roads are very poor, chiefly of sand or sand and clay. About 2500 tons of freight was moved, mostly by means of horse-drawn vehicles, but two gasoline motor trucks gave good service also.

Most of the penstock line was through a very rough country more or less timbered, which required the building of roads and special arrangements for handling material. The greater part of the steel pipe was unloaded at two yards, from which it was distributed into place on flat cars hauled along a narrow-gage track by hand winches and a horse-driven capstan.

Laying of steel pipe commenced about the middle of July, the construction being started from the power-house end. To supply his reaming machine, riveting hammers, calking chisels, etc., the contractor used a 250-cu.ft. air compressor operated by a 50-hp. motor. The pipe was lowered into the trench by two portable derricks made of 4x6-in. timbers and spanning the trench.

Building the Wood-Stave Pipe—The wood-pipe material was unloaded and sorted at several distribution points along the line and carried alongside or into the trench by lightly loaded wagons. The wood-pipe company had an experienced foreman and assistant and about 25 common laborers from the surrounding territory. On curves the average progress was about 200 ft. per day of 10 hr. and on tangents about 300 ft., the best day's work being about 420 ft. where the staves averaged about 25 ft. long. Laying the 1400 ft. of spruce pipe (by the power company) was necessarily slower because of the short staves

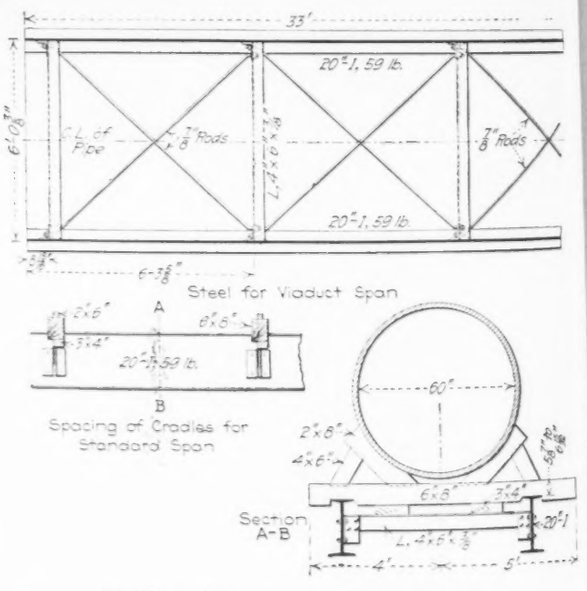


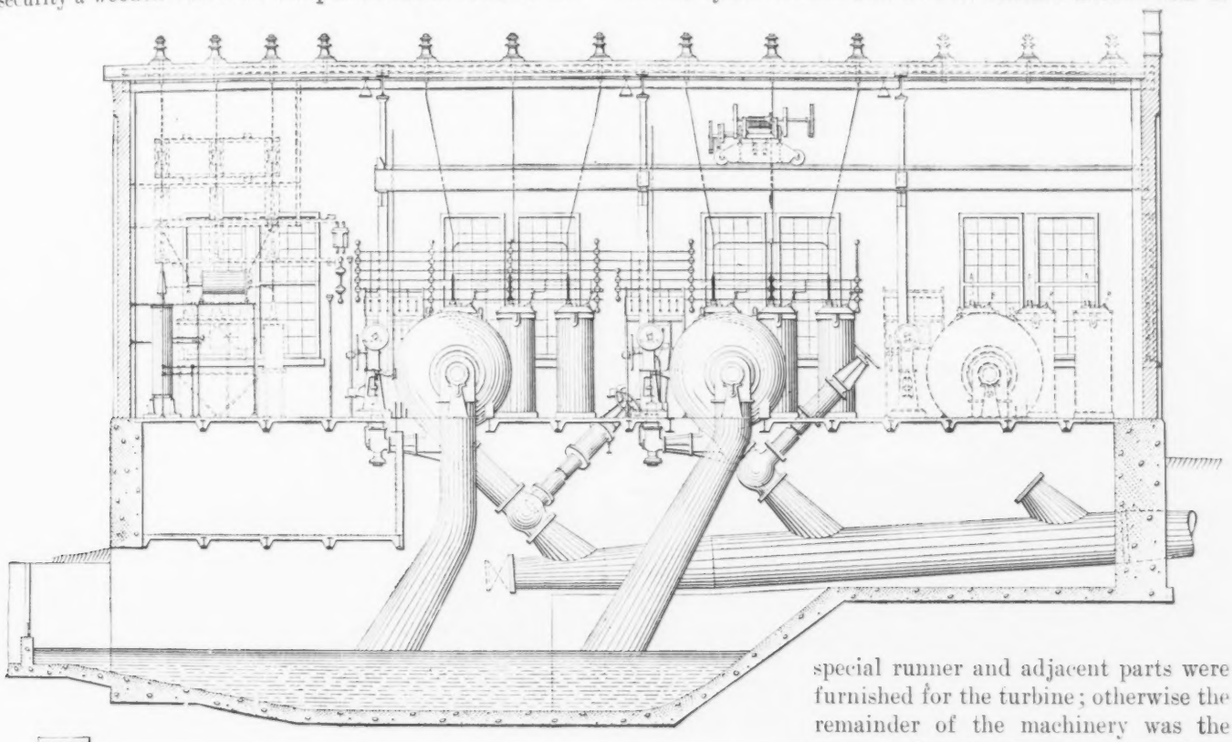
Fig. 4. Details of Trestle Cradle

and because the work had to be done in sheeted and braced trenches.

Temporary Station—On the wood-pipe line, at a distance of 6550 ft. from the dam, a steel T was inserted and from it a 3-ft. penstock, 1080 ft. long, was run to the temporary plant. The upper 580 ft. was made of spruce; the lower 500 ft. was made of $\frac{1}{4}$-in. steel plates with single-riveted lap joints. The staves were milled by the company and put together with one-piece bands. A

local firm made the steel pipe at the site. At the back of the T there was connected a 2-ft. steel pipe, 80 ft. high, performing the functions of a surge tank and vent. In the main (60-in.) wooden penstock, just below the end of the T, was put a steel bulkhead made of a boiler head, backed by an inside ring of staves held by bolts through the pipe and packed with oakum. As additional security a wooden bulkhead was placed about 1000 ft. farther down the line and the space between filled with water, with an overflow to prevent excessive pressure. This assisted in taking up shocks due to water hammer.

The temporary building, 18x40 ft. and 20 ft. high, was a frame structure covered with tar-paper and having a wooden roof, on which was mounted the high-tension switches and horn gaps. Concrete foundations were built for one hydro-electric unit and its tailrace underneath. A special runner and adjacent parts were furnished for the turbine; otherwise the remainder of the machinery was the same as that for the permanent plant. The maximum capacity obtained from the unit under the 200-ft. head was about 600 kw.



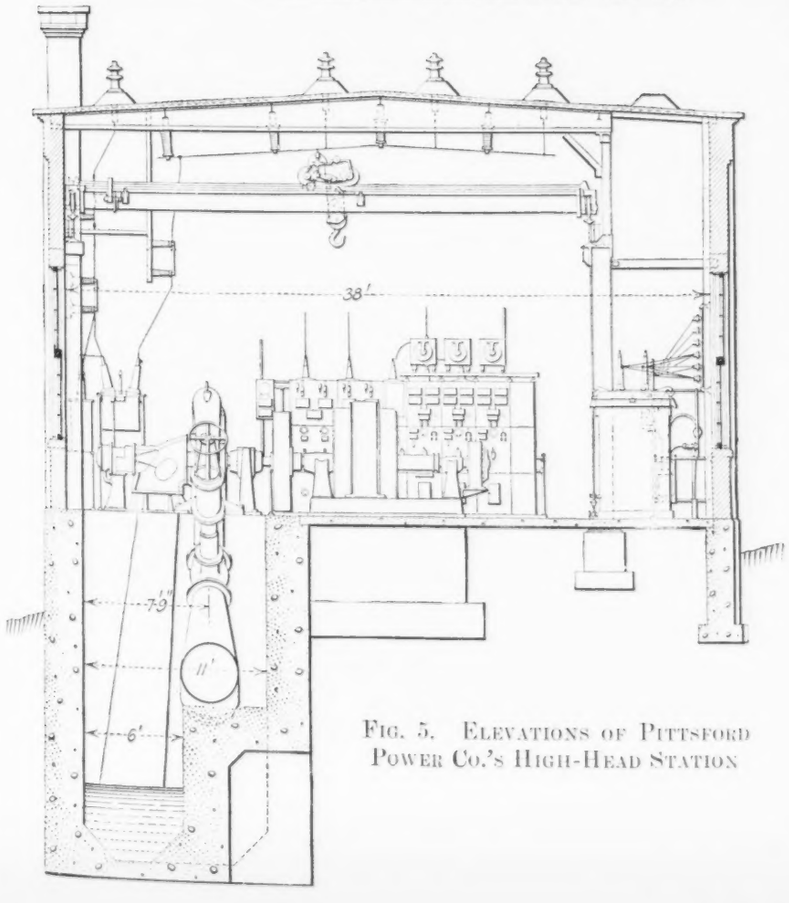


FIG. 5. ELEVATIONS OF PITTSFORD POWER CO.'S HIGH-HEAD STATION

The temporary plant was started on July 1 and kept in service until October, although the permanent plant was started in September. The apparatus from the temporary plant was then removed to the permanent plant. The temporary penstock was taken down and rebuilt at Molly Brook (Fig. 2), where a small collecting basin with a dam was built at an elevation of 80 ft. above the penstock to carry the water from that brook into the penstock instead of letting it flow unharnessed into the lower reservoir.

ORGANIZATION

This development of the Pittsford Power Co. was designed and constructed under the supervision of W. S. Barstow & Co., New York City. The wood-stave line was built by the Pacific Tank & Pipe Co.; the steel pipe by the East Jersey Pipe Corporation, the turbines by S. Morgan Smith Co., the governors by the Lombard Governor Co., and the electrical equipment by the General Electric Co.

The New Traymore Hotel at Atlantic City

SYNOPSIS—Details of design of one of the largest and most complicated reinforced-concrete buildings in this country. Eighteen stories high. Founded on wooden piles in sand beach of Atlantic Ocean. Structural details complicated by architectural layout. Notable for its rapid and efficient construction.

The Traymore, at Illinois Ave. and the Boardwalk, in Atlantic City, N. J., is one of the oldest hotels in that city of hotels. In 1909 a 12-story tower of reinforced concrete faced with building tile was built at the Boardwalk end of the lot to connect with the low frame structure which had long occupied the site. During the last year there has been under construction on the site of this old frame building an 18-story reinforced-concrete structure of exceptional size and architectural complications, which when joined to the slightly altered tower section forms one of the largest buildings of its type.

FIG. 1. THE WEST FACE OF THE TRAYMORE HOTEL JUST BEFORE COMPLETION

The hotel contains 700 bedrooms with baths, besides a great number of public rooms. Its construction is remarkable not only on account of the structural design but because of the speed with which it was erected. The old hotel was vacated July 1, 1914. The site was cleared ready for the builders Sept. 1, 1914. The new hotel was opened for service June 1, 1915.

REVISION OF OLD BUILDING

The Boardwalk tower, being of modern construction, was, with few changes, incorporated into the final structure. These changes comprise the erection of a three-story addition at the front, where before had been only porches and an entrance walk; the addition of several balconies and porches, the changing of the first three floors to meet the different levels of the same floors in the new building, and the architectural revision of the dome and upper works to fit in with the final architectural design of the building.

The old tower, of reinforced-concrete frame and tile face, was 55 ft., octagon in plan, and 12 stories high. The two lowest floors had to be removed to fit the levels of the adjoining new building, and cutting out these floors left the reinforced-concrete columns of the structure without permanent interior bracing for three stories. In order not to overstress these columns during construction through excessive unsupported height and wind stresses, lateral temporary shoring was used until two new floors and a gallery were installed. As these old floors came at different levels, the original column splices were midway between the floors, and in order to overcome the weakness thus left concrete collars (Fig. 4) were placed around the columns at the splices and reinforced with spiral and vertical steel. During the time the temporary shoring was in place the superstructure underwent strains from two very severe storms without apparent effect. The old concrete at this part was cut out with chisels and the rods cut through with gas torches.

The balconies which were added were supported on steel brackets stone-bolted into existing reinforced-concrete columns. These brackets were fireproofed with concrete and a concrete slab was put on top. The floor was then tested to twice the live-load without deflection, thus proving the value of stone bolts when properly executed (Fig. 4). Outside of the old building three stories of stores and porches were built of reinforced-concrete col-

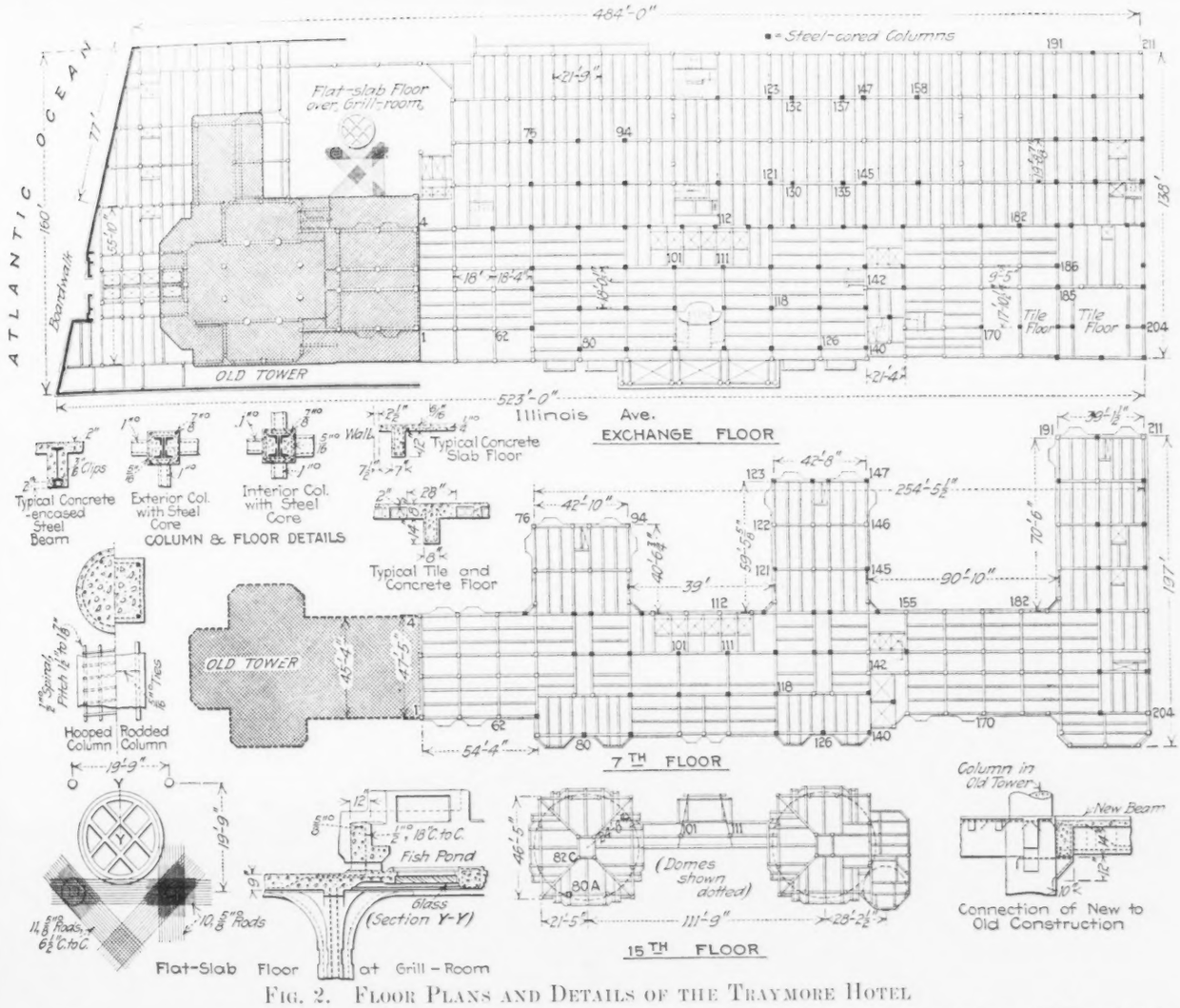


FIG. 2. FLOOR PLANS AND DETAILS OF THE TRAYMORE HOTEL

(The three plans show the main changes in floor plan; from them the continuous columns may be located by numbers. Old tower is shown hatched and in outline. Steel-cored concrete columns are denoted by solid section. Details are given of various column and floor sections)

umn and beam-and-slab construction. In this section no particular complication arose except in a few balconies and cantilever supports to porches and in the flat-slab roof to the grill-room, described hereinafter.

GENERAL DESIGN OF NEW SECTION

The addition, which with the revised tower forms the new Traymore Hotel, was built simultaneously with the alterations and additions to the old building. This addition is of reinforced concrete, rising at its highest part 18 stories (15 sleeping floors above 3 service floors), and is capped off with two large central domes with one smaller one, so that the total height from grade to top of dome is 230 ft. The facing walls are of 6-in. hollow tile faced with brick, and the old tower will be refaced with brick to blend in color and texture with the new surface. For the first three floors the building with the old section covers an area of 140x520 ft. Above the third floor the central section is somewhat smaller, and there are three wings, each extending farther than the other from the main building, thus permitting a maximum number of rooms to have an ocean view. From the eighth sleeping floor, or the 11th main floor of the building, the plan changes at each floor for architectural purposes, thus involving extreme complication in column location, and consequently in structural design. The plans in Fig. 2 show three floors where changes are most marked, and the relative area of the new to the old section is indicated.

FOUNDATIONS

The building site is entirely in beach sand, extending down as far as any investigations have gone. Grade is only 4 ft. above mean high water of the Atlantic Ocean, and the ocean at extreme high water flows up practically

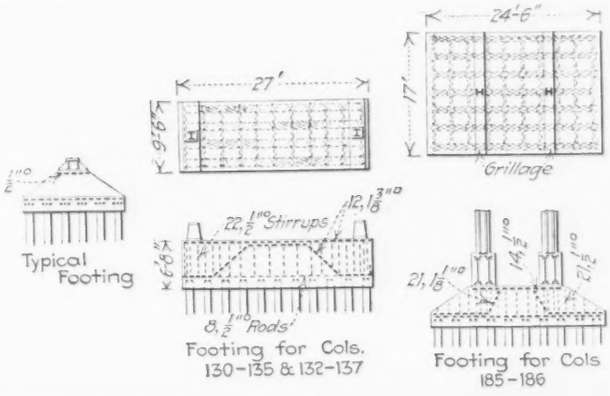


FIG. 3. SOME TYPICAL FOUNDATION DETAILS

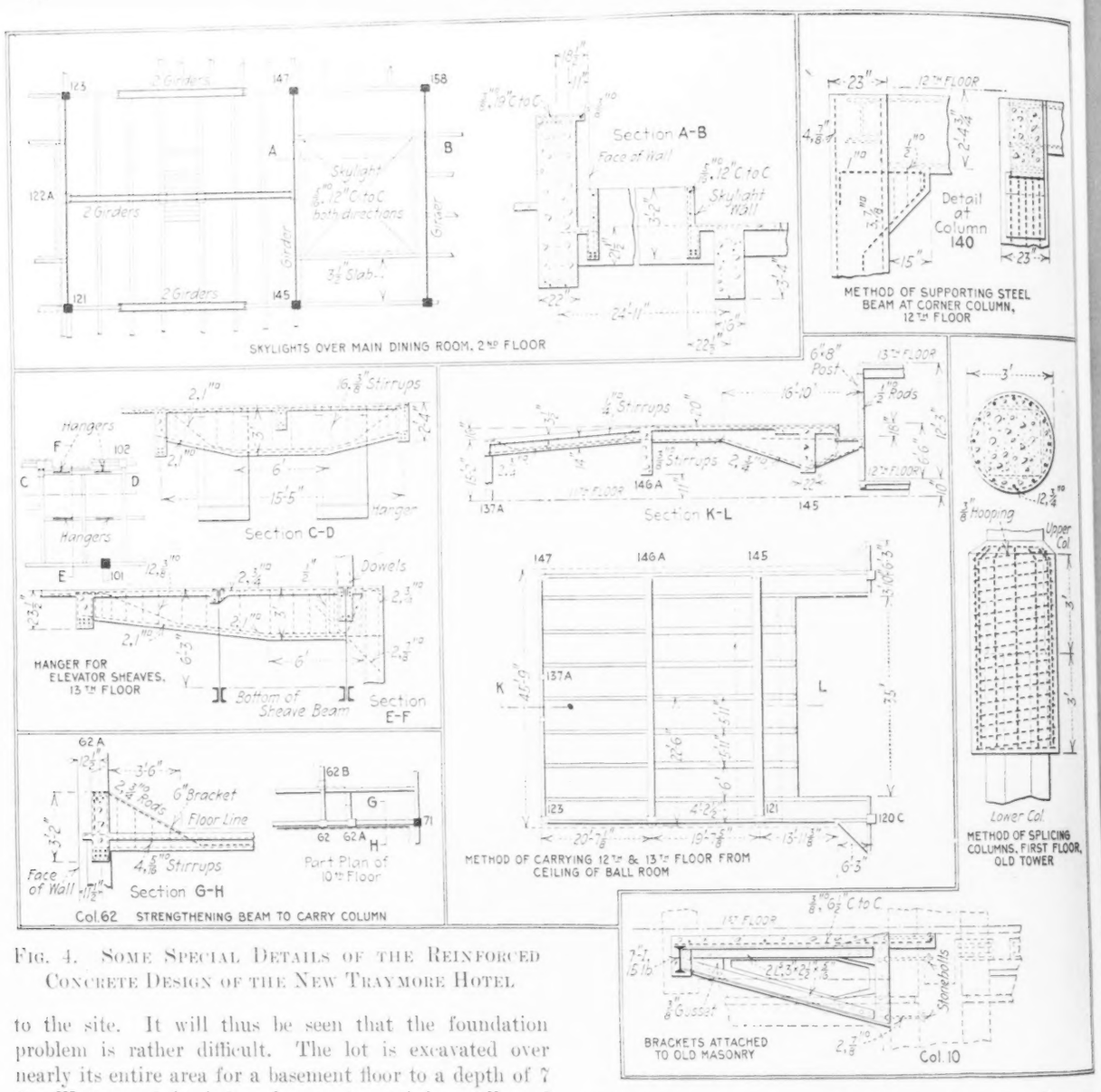


FIG. 4. SOME SPECIAL DETAILS OF THE REINFORCED CONCRETE DESIGN OF THE NEW TRAYMORE HOTEL

to the site. It will thus be seen that the foundation problem is rather difficult. The lot is excavated over nearly its entire area for a basement floor to a depth of 7 ft. Waterproofed reinforced-concrete retaining walls and floors were built for the various service pits required, which run from 8 to 11 ft. below the basement floor.

The foundations to the columns consist of reinforced-concrete mattress footings on wooden piles. These piles average 18 ft. long, are 12 in. at the butt and 6 in. at the tip. They were jetted into place, but afterward were tapped with a steam hammer to practical refusal. In order to test the behavior of the pile, one of each group was retapped several days after jetting the group, and it was found that they maintained their refusal position.

On account of the varying loads on the piles during erection, due to the peculiarities of the plan, it was anticipated that at times some piles would be fully loaded far in advance of adjacent piles. In order to overcome any tendency to unequal settlement a rather low unit load (15 tons) per pile was used. This load is considerably less than that used on the original tower, which was not subjected to this condition, being more uniform in plan. From tests on piles on an adjacent plot it was decided that a long pile, say 32 ft., did very little more work, if any, than a short one of 16 ft., and that a pile by itself developed greater unit resistance than one of a number in a cluster, the pile spacing being 2 ft. 6 in. c. to c. As shown in the details in Fig. 3, where exceptional loading required it, the pile footings were reinforced with steel girders.

As plunger elevators were installed and plunger wells were sunk after the main construction of the building, it was necessary to keep the jetting above the lowest point of the plunger well so as not to disturb the soil around the piles through which these plungers extend.

STRUCTURAL DESIGN

The structural design is complicated by the architectural details and the arrangement of floor space demanded for a large hotel. In general the floors of beam-and-slab reinforced concrete are carried on straight rodded reinforced-concrete columns, but in different places tile-and-concrete and girderless floors are used and columns are reinforced with either hoops or structural-steel cores. Bay windows, bracketed porches, curved dormers, domes, pilasters, etc., all added to the difficulty of detailing the concrete work.

Column Layout and Design

The offsetting from floor to floor complicated the column layout, and on this account the girder design. There are 179 columns starting from the foundation. All these continue up through the first three floors to the first sleeping floor. At this floor 15 columns stop and carry girders which support 20 additional columns starting

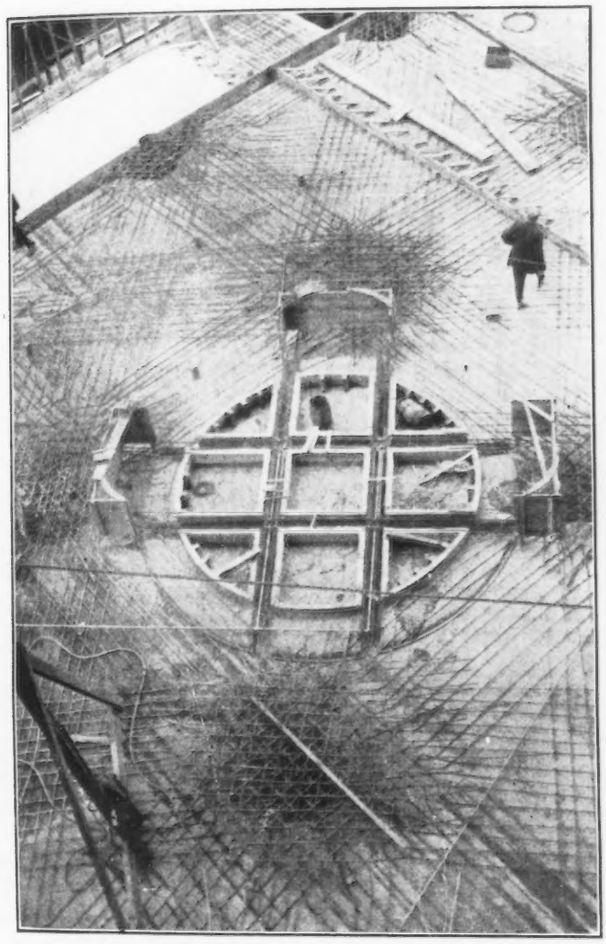


Fig. 5. Mushroom Flat-Slab Floor over Grill-Room under Construction
(See detail in Fig. 2 for design and location)

at that floor. At the second sleeping floor 12 columns stop and carry girders supporting 17 additional columns. At the ninth sleeping floor 6 columns stop and carry girders supporting 8 additional columns. At the 10th sleeping floor 13 columns stop and carry girders supporting 18 additional columns. At the 11th sleeping floor 10 columns stop and carry girders supporting 10 additional columns. At the 12th sleeping floor 13 columns stop and carry girders supporting 11 additional columns. At the 13th sleeping floor 25 columns stop and carry girders supporting 22 additional columns (see View *A* in Fig. 7).

Thus of the 179 columns starting at the foundation there are in addition 132 columns starting on girders at the various floors. Of the 41 columns that run up to the springing line of the dome only 9 continue to their own foundation. The 32 other columns are supported by girders at different floors.

In the upper part of the building, where most of these new columns start, the sections are of the straight-rodded type. Where the loads are heavy and space would not permit a concrete column, the steel-cored columns shown in detail in Fig. 2 are used. In these cases steel bracket angles are framed into the steel of the column to carry the reinforced-concrete beams, and rods are placed both ways around the columns to take negative bending moments. In some cases, as shown in Fig. 4, an outside girder had to be strengthened to take the load from a column starting at that floor.

Floors

A typical beam-and-slab floor is shown in Fig. 2. At the front of the building over the grill-room, where a flat ceiling was desired, it was considered that a flat-slab floor of the "mushroom" type answered the purpose best. The details are shown in Fig. 2 and a view during construction is given in Fig. 5. Here, too, a fish pond is carried on the floor with glass bottom visible from the grill-room below, which detail added to the difficulties of design. Over the mezzanine and first floors long-span tile and concrete joist slabs, as shown in Fig. 2, were detailed so as to provide ceilings comparatively free from beams in the public rooms of the lower floors.

Special Details

Mainly on account of the offsetting, a number of special structural details had to be used. These cannot be described fully, but a few of the more important ones will be noted. Most of these are shown in detail in Fig. 4. Their location in the main building may be traced from the column numbers which are shown in both Fig. 2 and Fig. 4.

From the second to the ninth floor the construction is fairly typical, except for the cantilevered bay windows, both of slab and of beam type, and the balconies on concrete brackets. On the second floor, in the central wing, large steel girders were used to support the columns coming down from the 13th floor, thereby enabling the American-plan dining room on the second floor to be free of central columns. Above the 11th floor the building begins to reduce in size, and consequently offset columns

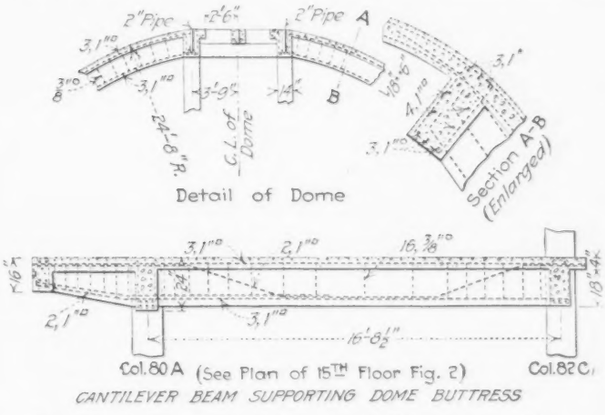


Fig. 6. Reinforced-Concrete Details of Dome

commence to occur. Here also is a pitched roof section (View C, Fig. 7).

Above the 13th floor special details had to be provided to support the groups of elevator sheave beams, which are suspended from the floor-beams by hangers.

The 14th and 15th floors are practically all cantilever members supporting the large ornamental brick buttresses

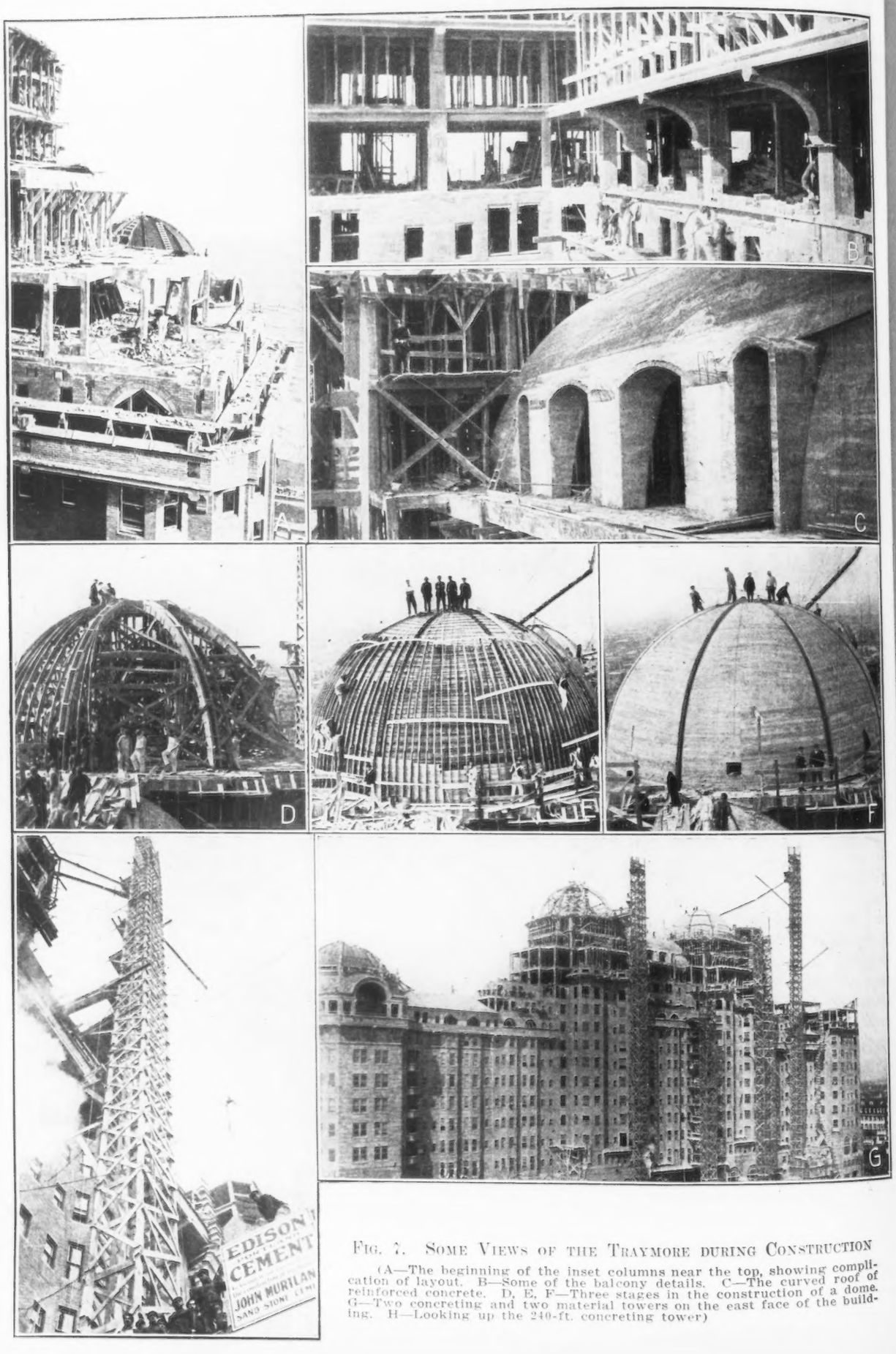


FIG. 7. SOME VIEWS OF THE TRAYMORE DURING CONSTRUCTION

(A—The beginning of the inset columns near the top, showing complication of layout. B—Some of the balcony details. C—The curved roof of reinforced concrete. D, E, F—Three stages in the construction of a dome. G—Two concreting and two material towers on the east face of the building. H—Looking up the 240-ft. concreting tower)

(Fig. 2). These buttresses run down 3½ stories, about 35 ft., and extend out a maximum distance of 13 ft. They are supported on cantilevers framing into a diagonal girder of the floor construction, which takes a negative moment from the kick-up (Fig. 6). The weight of each dome is 240 tons, and two-thirds of this is carried by concrete girders not directly meeting columns.

A special detail occurs above the 12th floor, where a reinforced-concrete girder, 44 ft. long, over the ballroom carries on secondary cantilever members the columns of the floor above and on hangers the floor below (see detail in Fig. 4).

Loads and Stresses

The live-loads used in the design were as follows:

	Lb. per Sq.Ft.
Roof	30
Sleeping floors	60
Laundry floor (plus special machinery loads)	150
Kitchen and exchange floor	100
Garden (plus dead-load of earth fill)	200

The live-load coming on girders was reduced 10 per cent. when carrying bays of not less than 100 sq.ft. and 2 per cent. additional for every additional 100 sq.ft. above 100 sq.ft. The live-load on columns except on roof, top floor and exchange floor were reduced 5 per cent. per floor until 50 per cent. of the live-load was reached, when such reduced load was used throughout the remaining floors.

The following stresses were used:

	Lb. per Sq.In.
Concrete in direct compression	500
Concrete in compression under bending	500
Concrete in shear	100
Concrete in bond to steel	75
Steel in tension	16,000
Steel in shear	10,000
Ratio modulus of elasticity of concrete to steel	1 to 12

In a few special cases the steel was stressed to 20,000 lb. tension where the load carried had quite a number of floors and a large area of live-load was included in the load. All uniformly loaded members were designed with a bending moment of $WL/8$, taking the length as face to face.

The tile-and-concrete joist floor slabs were designed as a series of T-beams 16 in. c. to c. In the design of beams and girders the horizontal shears were resisted by concrete and steel stirrups, the vertical shear generally by the concrete alone; but in several cases where the shears were excessive the main reinforcing steel was allowed to assume part of the shear, in which case the rods were embedded into the concrete, giving sufficient resistance in bond to resist their portion of the vertical shear.

The "mushroom" slab was designed in accordance with the general practice in use in the Philadelphia district; the diagonal bands with a moment of $WL/24$ at center of span and the straight bands with a moment of $WL/12$ at the center of span. All rods extend into the adjacent panel to the one-quarter point, which doubles the reinforcing steel over the support, at which place the rods were bent up to within 1 in. of top of slab. The thickness of the slab was determined from the shear brought about by the load, and the column caps were made one-quarter of the span in diameter. These caps were designed for bending produced by unequal loading. Where the pool occurred the latticed concrete beams were taken into the bands of the adjacent mushroom panel and the bending moment of these bands figured accordingly, having in addition to a uniform load the concentrations from the lattice beams.

The columns were figured as follows:

Plain reinforced-concrete columns—500 lb. per sq.in. over entire area, with 1½ per cent. of vertical steel and tied with ¼-in. round ties placed 12 in. on centers.

Hooped columns—1000 lb. per sq.in. on the concrete inside the hooping, with 1½-in. covering of concrete outside of hooping. The vertical steel rods and spiral hooping were designed from the Considère formula for hooped columns.

Steel-cored columns—Core was figured to take all the load, the concrete incasement being only considered as fireproofing, except that its rigidity permitted the diameter of the column to be taken as the size of the concrete casing when figuring the radius of gyration for reduction. This produced about 15,000 lb. per sq.in. as an allowable unit stress on the steel cores.

With steel cores, cast-steel bases were used, figured in the usual way and anchored to concrete footings. The footings were designed with mattress reinforcement, developing sufficient resistance to take reactions from the piles, and the reinforcing steel was placed each way over the tops of the piles. Where cast bases rest on concrete footings these footings were reinforced 2 in. below the top to permit figuring 500 lb. per sq.in. as a bearing resistance.

The domes are figured as true domes, placing sufficient horizontal reinforcing bonds completely around them with a 4-ft. lap at splice to resist the thrust from the weight of the portion of the dome above the ring being designed. Where openings were cut in the dome, secondary members were incorporated above and below the opening to take up the stress broken by opening. In this method the thrusts were resisted, while the ribs were used as arched beams on the interior of the shell.

Construction Details

The feature of the construction was the rapidity with which so involved a structure was completed and is worthy of a separate article to appear in an early issue. Meanwhile in views *G* and *H*, Fig. 7, the 256-ft. chuting towers may be noted.

Personnel

The architects for the new Traymore Hotel were Price & McLanihan. The structural features were designed by Otto H. Gentner, Jr., and F. Dickinson Shaw, Associate Consulting Engineers, and the contractor was Cramp & Co.—all of Philadelphia, Penn.

A Peculiar Accident occurred in the building of the Society for the Prevention of Cruelty to Animals in New York City on May 27. A large steel gas reservoir, used for asphyxiating dogs and cats, exploded while in use. The tank is a steel chamber 5 ft. high, 5 ft. wide and 10 ft. in length. The cats to be killed are placed inside of the tank and illuminating gas from the city mains is discharged into it. In the published reports of the accident the remarkable cause assigned for the explosion is that the sharp claws of the cats inside clawing the sides of the tank must have produced a spark and ignited the contents. It is extremely doubtful that a material no harder than a cat's claws rubbing on soft steel could ever produce a spark. It may be suggested, however, that cat's fur when properly agitated is one of the oldest and best-known sources of electric sparks. If the tank had been filled with illuminating gas alone, any sparks produced would of course have been harmless, since there would have been no oxygen with which the gas could unite. Probably, however, as the tank at the start of the process is filled with air as well as cats, a gradual mixture takes place between the air and the gas as the latter is discharged into the tank and thus an explosive or ignitable mixture may be formed. While the explosion of the tank was powerful enough to blow out some of the windows in the building, the mixture ignited was evidently not that which would produce complete combustion or the explosion would have been of much greater violence.

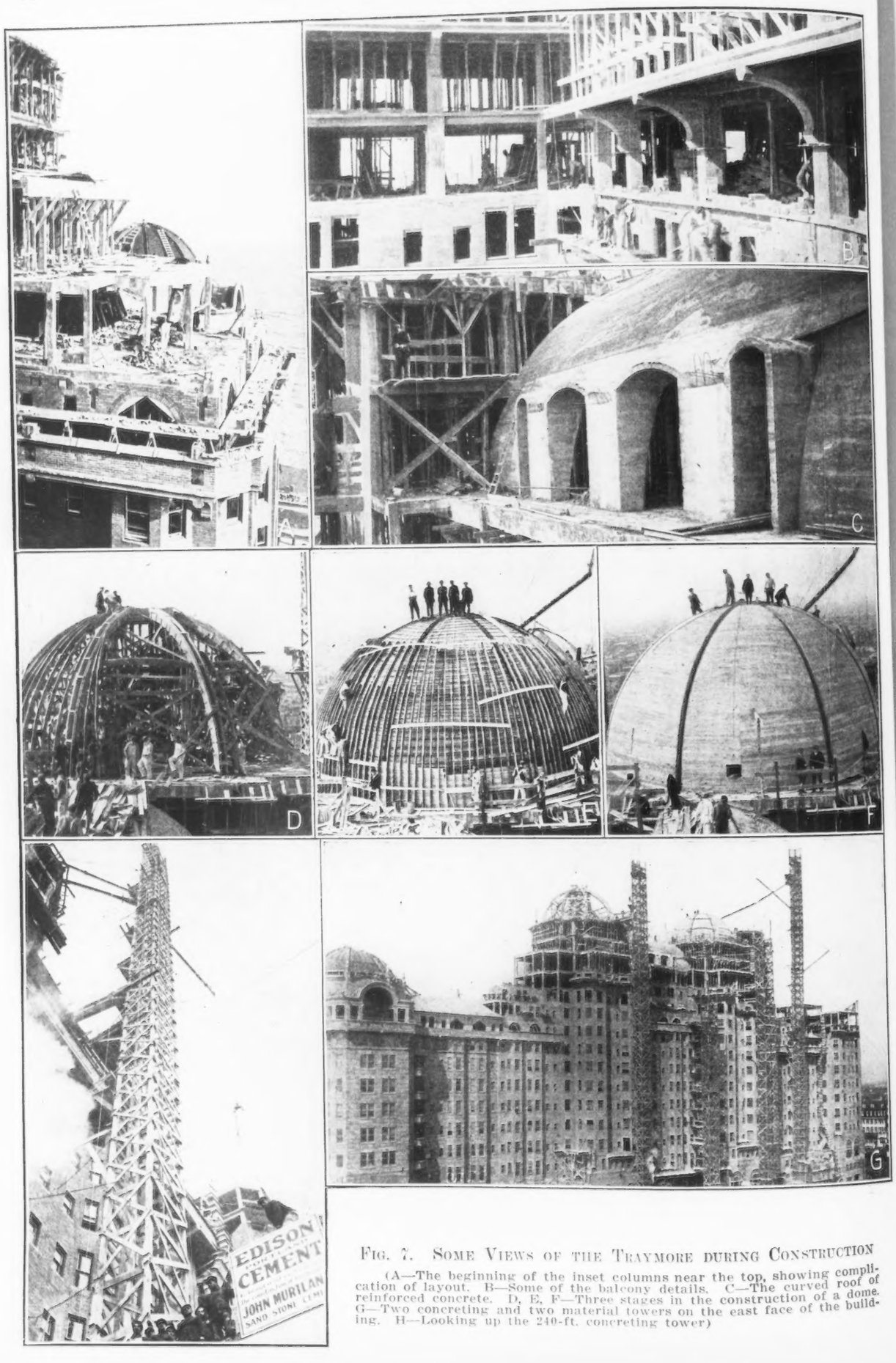


FIG. 7. SOME VIEWS OF THE TRAYMORE DURING CONSTRUCTION

(A—The beginning of the inset columns near the top, showing complication of layout. B—Some of the balcony details. C—The curved roof of reinforced concrete. D, E, F—Three stages in the construction of a dome. G—Two concreting and two material towers on the east face of the building. H—Looking up the 240-ft. concreting tower)

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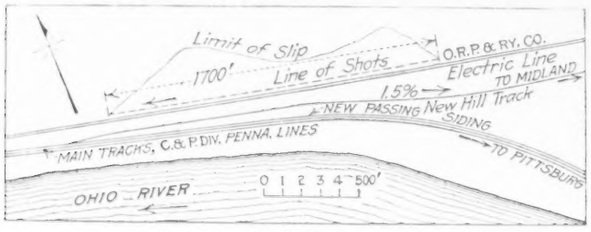
Field and Office

Stopping a Difficult Slide by the Use of Explosives

The Pennsylvania Co. on its C. & P. division recently built a spur track about a mile long from its main track to the plant of the Pittsburgh Crucible Steel Co. at Midland, Penn. In excavating for the new roadbed, which for a portion of the way lies along and below the Ohio River Passenger Ry., a double-track electric line, a bad slide developed about 1700 ft. long, extending back from the cut a maximum width of about 350 ft. to the face of a rock cliff. About 40,000 cu.yd. of material in excess of the preliminary estimate slid into the roadbed prism and was removed by a steam shovel.

As may be seen from the sketch showing an approximate typical section through the slide, the electric railway required considerable work to keep it to line and surface sufficient to allow traffic to pass on it. For a time it was necessary to abandon the track on the side toward the new cut, using the other track past the slide. The track being used was lined back up the hill from time to time and brought to surface with blast-furnace slag (see Fig. 2; the shovel in the sliding bank in the middle right of the picture gives a measure of height).

In a thorough study of soil conditions it was found that a sliding plane existed at the top of a bed of fireclay about 10 ft. below the surface of the sliding mass.



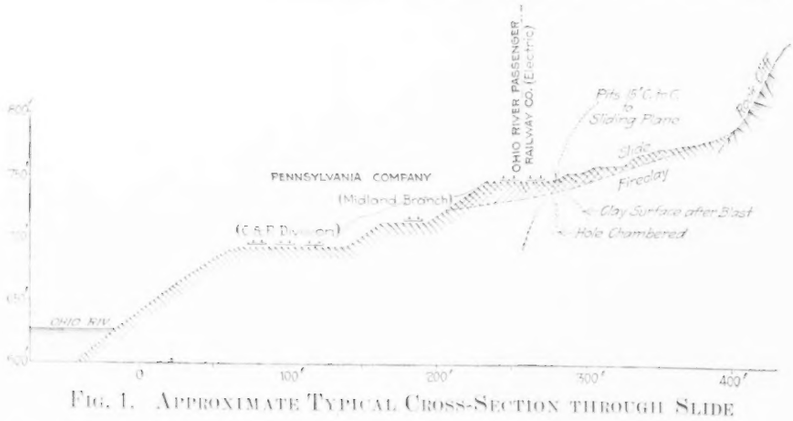


FIG. 1. APPROXIMATE TYPICAL CROSS-SECTION THROUGH SLIDE

The method adopted to stop the slide, which is described in what follows, proved a complete success. A similar plan was considered by the Big Four in the case of a slide near Cincinnati, described in ENGINEERING NEWS, May 16, 1907, p. 536, but was not carried out for fear the explosives themselves would start heavier slides. The material on the Big Four was wet yellow clay lying over a species of soapstone.

Holes large enough for a man to work in were dug on 15-ft. centers to the surface of the fireclay. Then a 2-

FIG. 2. BLAST-FURNACE SLAG RAILWAY FILL

in. hole was drilled 10 ft. into the clay and the lower end expanded with two sticks of 40% dynamite. Three kegs of black powder were then placed in the enlarged hole and the charge fired. The clay was lifted into mounds which connected into each other at about the surface of the clay.

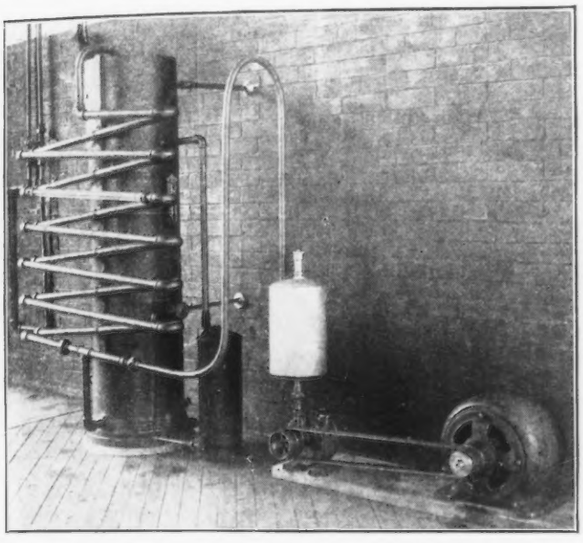
The plan to stop the slide was devised by E. F. McCrea, Division Engineer at Cleveland. Field work was done by the H. E. Culbertson Co. under the direction of Mr. McCrea and H. W. Brown, Assistant Division Engineer, with C. P. Spangler as Engineer in Charge.

The Big Four slides referred to above were stopped by a double row of piles 8 ft. apart each way, staggered, which were driven near the toe of the slope. In one instance it was necessary to make a screen of woven brushes with a filling of cinders to prevent the material flowing away between the piles. A similar condition of sliding ground in a railway cut, which was also stopped by driving piles, was described in an article in ENGINEERING NEWS, Sept. 13, 1906, on "Railway Construction through Sliding Ground in France."

Accelerated Pipe-Corrosion Test Machine

A machine has been developed by the National Tube Co., of Pittsburgh, for the rapid testing of iron and steel pipe, as to resistance to corrosion, more nearly under service conditions than has been possible before.

The scheme is to circulate a mixture of air and water through a series of pipes to be compared, thus giving the same conditions on each. With a constant circulation of hot water saturated with oxygen corrosion proceeds



PIPE-CORROSION TEST APPARATUS OF NATIONAL TUBE CO.

about twelve times as fast as on ordinary hot-water lines.

A set-up of the apparatus is shown in the accompanying view. There is an open hot-water tank, a gas-burning water heater with control thermostat, an air pump and injector foot, and a test coil made up of lengths of the various kinds of pipe to be tested. One length is made of glass for observation. The air, which is injected at the bottom of the coil, causes the water to flow up and spill over into the storage tank. The air supply is regulated so that the flow is kept down to about 1½ gal. per min., at which rate the corrosion products are not swept away.

Construction Plant at the Nepaug Dam

Work on the 128-ft. masonry arch dam of the Nepaug reservoir for the additional water-supply of the city of Hartford, Conn., is progressing rapidly, as the accompanying views show. Fig. 1 is the contractor's (Fred T. Ley Co., of Springfield, Mass.) construction plant; Fig. 2 is the concrete distributing tower, which is being carried up to a height of over 200 ft.; Fig. 3 is a general view of the dam site with cyclopean masonry of the foundation in place, and Fig. 4 shows how the contractor solved the transportation problem. A blacksmith and general repair shop is on the left of the railway (Fig. 4), below the sand and stone bins. An air-compressor plant is above the dam site to the right in Fig. 3.

When the contractor began work in the early spring the Nepaug valley below the dam site was about as wild and rugged as any western cañon. Fortunately, a branch line of the New York, New Haven & Hartford R.R. crosses the river about 4000 ft. below the dam site, and the contractor has admirably solved his transportation and supply problem by building a standard-gage railway to connect his construction plant with this branch line.

Broken trap rock for the concrete is purchased from the railway company and hauled from a quarry and stone-crushing plant about 25 mi. distant. Sand and gravel pits are near the contractor's railway, and boulders are plentiful. The broken stone is taken up the inclined trestle (Fig. 1) and dumped directly into elevated bins. Sand and gravel are dumped in the rear of the bins into a hopper, and after passing over a bar screen, the larger rocks and boulders go through a crusher. From below the hopper these materials are elevated by bucket conveyors to the tops of their respective bins.

The long low building on the left (Fig. 1) is the cement house. The bags of cement are opened and the cement is dumped into a hopper at the extreme right end of a passageway under the bins, where it is chuted into cable-cars, which in their passage under the bins receive the correct proportions of sand and stone through manually operated gates in the bins overhead. There are two parallel lines of cable-cars, each running up an incline at the right end of the bins and dumping automatically into two concrete mixers at the foot of the tower (see Fig. 1).

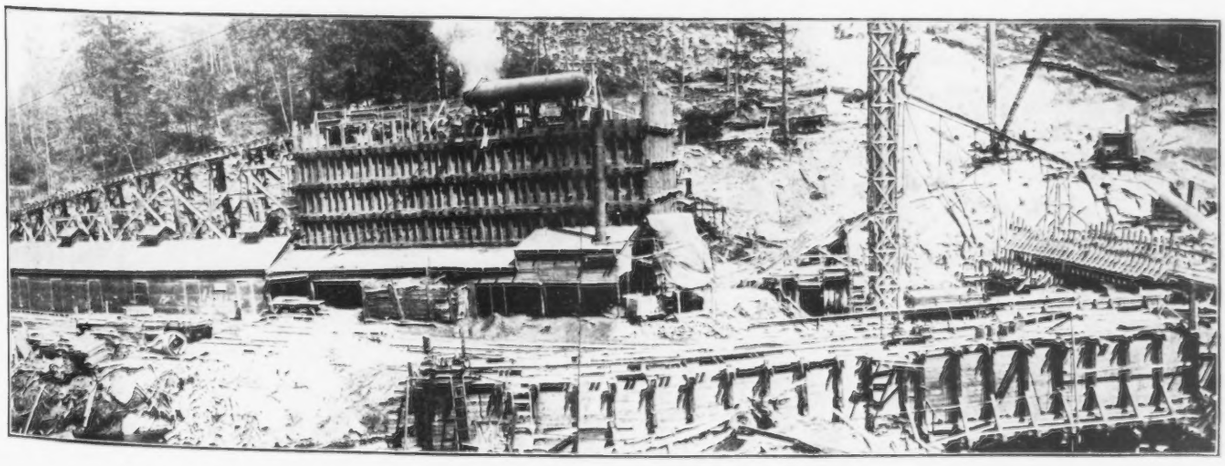
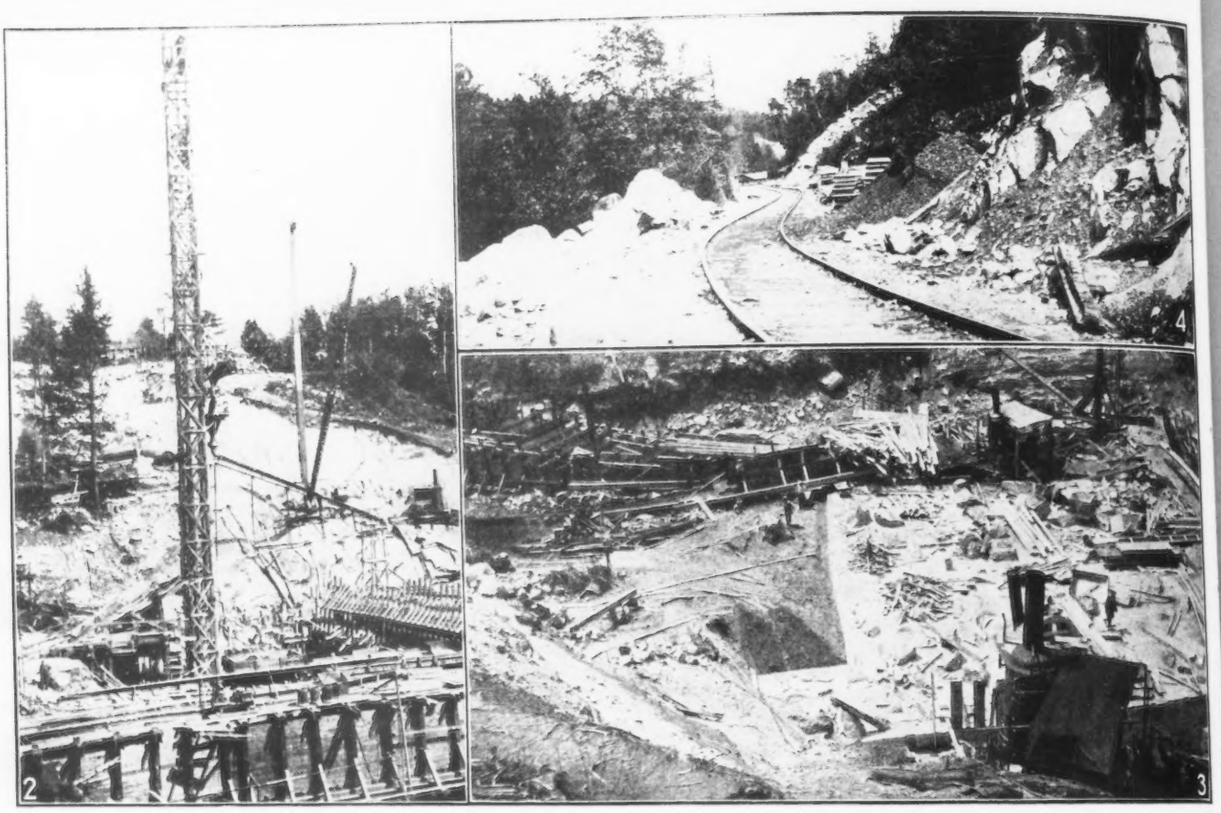


FIG. 1. CONSTRUCTION PLANT AT THE NEPAUG DAM; HARTFORD, CONN., WATER-SUPPLY



FIGS. 2 TO 4. BUILDING THE NEPAUG DAM OF THE HARTFORD, CONN., WATER-SUPPLY

(Fig. 2—Concreting tower over 200 ft. high. Fig. 3—Lower course of cyclopean masonry in place. Fig. 4—Contractor's standard-gage railway)

FIG. 5. DERRICK FOR HANDLING ENDS OF CONCRETING SPOUTS

From the tower the concrete is distributed by spouts, one from each mixer elevator, to any part of the dam. The method of handling the far end of the spouts is unusual. It was designed to have them supported on horses or A-frames and shifted about in that way, but this was so cumbersome that the superintendent, Robert Coombs, hit upon the derrick scheme shown in Fig. 5. This derrick is a single mast with two right-angle brackets, or booms, one for each end of the distributing spout. These derricks are planted in wood boxes extending to the hardened course of concrete below and each is supported by five guy wires. The concreting spout from the main tower connects with the elbow of the derrick's distributing spout, as Fig. 5 shows.

For handling the boulders or "plums" for the masonry the contractor has two large stiff-leg derricks reaching to any part of the structure. So to move the small concrete-distributing derricks from place to place one of these large derricks is used to pick up the whole outfit bodily, and the guys being loosened, the shift is made in about 15 to 30 min. with two men, whereas the original scheme, with spout supported on horses, required 8 men working twice as long.

The Nepaug dam is a part of a new large water-supply project now under construction for the city of Hartford under a board of water commissioners, for whom Caleb Mills Saville is Chief Engineer. The dam is to be approximately 600 ft. long on top, with a 290-ft. spillway section. The radius of the center line is 390 ft. It has contraction joints every 43 ft. and an interior inspection gallery. The new reservoir will have a watershed of 32.4 sq.mi.

New Hydrographic Signal of the U. S. Coast and Geodetic Survey

A hydrographic or triangulation signal 80 to 90 ft. high, which can be built for $1 per vertical foot, including all materials, transportation of party and outfit, pay and subsistence—a signal which gives a maximum of height and strength for a minimum of material and labor—has been designed by J. S. Bilby, signalman of the United States Coast and Geodetic Survey. Several signals of this type have been built since Jan. 1 on the Florida coast.

The elements of the signal are (1) the foundation, (2) the scaffold, (3) the superstructure, (4) the target and (5) the guys.

1. Foundation—Stakes are driven at the corners of an 11-ft. square (Figs. 1 and 2). The post-holes are 3x3 ft. by 3 ft. deep. In the bottom of each hole is a footplate 2x8 in. by 2½ ft., made of two pieces of 2x4 held together by pieces of 1x4 nailed across the ends. The scaffold legs are toe-nailed to the foot-plates. Fig. 3D shows a plan of

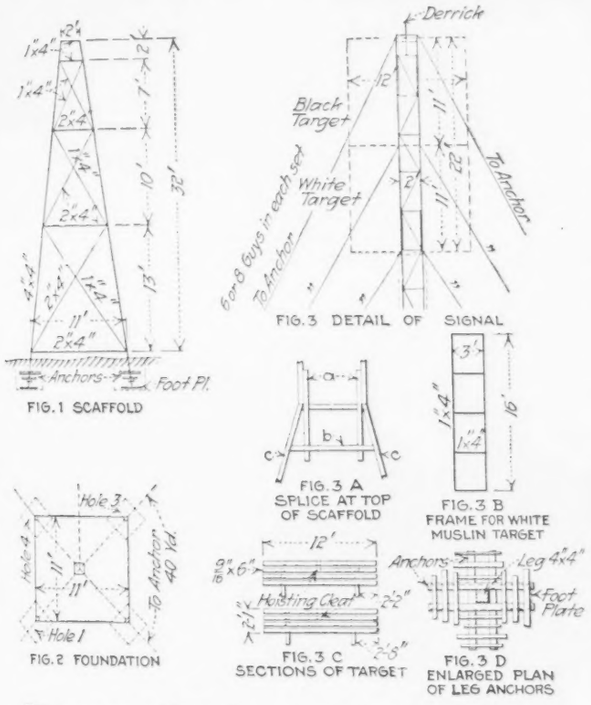


FIG. 1 SCAFFOLD
FIG. 3 DETAIL OF SIGNAL
FIG. 3 A SPLICE AT TOP OF SCAFFOLD
FIG. 3 B FRAME FOR WHITE MUSLIN TARGET
FIG. 2 FOUNDATION
FIG. 3 C SECTIONS OF TARGET
FIG. 3 D ENLARGED PLAN OF LEG ANCHORS

DETAILS OF A NEW HYDROGRAPHIC SIGNAL, UNITED STATES COAST AND GEODETIC SURVEY

the leg anchors. These are 2x4's about 2½ ft. long, placed in two sets of two pieces each on each leg. The first set of anchors is nailed to the leg near the bottom with 20d. nails, five nails to a piece. Earth is filled in to the top of the anchor pieces and scrap pieces of timber are nailed on top of them. The second set of leg anchors is then nailed in place just above and at right angles to the lower set, filled in and covered with scrap timber as before and the holes then filled and thoroughly tamped.

2. Scaffold—Fig. 1 shows the working plan and dimensions of the scaffold; outside measurements are shown except where c. to c. dimensions are specified in spacing horizontal ties. Two sides of the scaffold are completely framed and assembled on the ground and raised to place with a tackle. The ties and braces are on the outside, so one scaffold sideframe has to be turned over before being raised to position. The horizontal ties and diagonal braces of the other two sides are nailed on after the four legs are set upright.

In framing the scaffold the first step is to make the legs, which are 4x4 in. by 36 ft. long, built up by nailing together 2x4's, breaking joints by at least 4 ft. The joints are strengthened by pieces of 1x4 in. by 3 ft. nailed over them. Marks are made on the legs for horizontal ties at 2, 9, 19 and 32 ft. from top of ground for the ties and braces. For the 2x4's 20d. nails are used and 8d. for the 1x4's. The opposite sides, Nos. 1 and 3 (see Fig. 2), are raised by a line and tackle of two single blocks, from posts about 60 ft. from the scaffold. The legs are not toe-nailed to the foot-plates and the anchors made until the scaffold is completely erected.

3. Superstructure—The superstructure is 2 ft. square with legs 2x4 and ties and braces 1x4, framed as shown in Fig. 3 of the completed signal. All ties are 2 ft. long and spaced 4 ft. on the legs. The braces are all cut from one pattern. Fig. 3A shows how the superstructure is joined to the top of the scaffold. The pieces marked *a* are 2x4's 4 ft. long; those marked *b* are 2x4's nailed across the scaffold legs *c*. The legs for the superstructure are sent aloft one piece at a time and set on top of *c* and nailed to *a*. The second section of legs is spliced on the first by nailing pieces of 2x4's 4 ft. long on the inside of the legs. The legs, ties and braces are all marked and cut from patterns before being sent aloft, the legs being raised singly and the braces in sets of four. One man aloft, inside, nails the pieces in place, while another on the ground cuts the pieces and sends them up by means of a hauling line.

4. Targets—The top target is 11x12 ft., painted black, and beneath it is one of the same size painted white. They are made of dressed boards $\frac{9}{16}$x6 in. by 12 ft. long in five sections (10 in all) of four boards each, nailed to pieces of 1x4 in. by 3 ft., with 1-in. spaces between the boards. Fig. 3C shows a detail. The targets are fastened to the legs by 8d. nails, five nails being used to each board in each leg. Below the target the superstructure is covered with white muslin.

5. Guys—The structure may be from 80 to 90 ft. high before it is necessary to attach any guys. The guy anchors are about 120 ft. distant from the base of the structure. Six anchors are used when a target shows in one direction and eight anchors for a signal with targets showing in four directions. The anchors are 8x2-ft. timber frames buried in 3 ft. of earth. The guys are No. 8 galvanized-iron wire attached to the superstructure, as shown in Fig. 3. The guys are set by tackle.

For hydrographic work the signal described can be seen from 10 to 12 mi. In no case should the size of the target be increased without additional guy wires. All lumber is dressed on four sides. Two men can build the signal in an average of two days when the material is on the ground.

The following tools are necessary: Two hand saws, one axe, one carpenter's level, one bevel, one try-square, two rules, one hatchet, two clawhammers, two paint brushes, one shovel, one spade, three 6-in. blocks, 320 ft. of ½-in. rope and 125 ft. of ⅝-in. rope.

The following materials are necessary for an 84-ft. signal: 40 pieces of timber $\frac{9}{16}$x6 in. by 12 ft. long; 60 pieces

2x4 by 16 ft. long; 75 pieces 1x4 by 16 ft. long; 40 pieces 1x4 by 12 ft. long—making in all 1333 ft. b.m.; 50 lb. 8d. nails; 25 lb. 20d. nails; ½ gal. white paint; ½ gal. black paint; 12 yd. of white muslin; ¼ lb. 8 oz. tacks; 2000 ft. No. 8 galvanized iron wire.

Clean-Up Work after Erecting Three 600-Ft. Radio Towers

After the erection of one of the 600-ft. self-supporting steel radio towers at Darien, C. Z., there was still considerable work to be performed in the way of cleaning up. First of all, two channels were laid horizontally across the top of the horizontal beams and bisecting the angle formed at each tower by the lines to the other two towers. Two sheaves were mounted between these channels, one directly over the center of the tower, the other just outside the edge of the deck at the top of the tower. These sheaves were to carry the cable used to hoist the antennæ. The cables of the antennæ are held permanently in place by pennants hooked into shackles at the outer end of the sheave supports. The hoist cable is carried down the inside of the tower to an electric-motor-driven hoist located on a platform framed into the steelwork about 40 ft. above ground.

A ladder is built on one of the legs of the tower from the foundation to the top. It is composed of ¼x5-in. side plates with two ⅝-in. diameter rungs riveted in each step. Ten landing platforms are provided, the lowest being at the 110-ft. level. While it involves considerable labor, it has been found to be quite safe for any person physically fit to climb to the top of the tower; dizziness is prevented by the climber continually confronting the broad back of the tower leg. Workmen on the tower habitually rode up and sometimes down by means of the hoisting cable as long as erection was in progress, but for final bolting and painting the ladder was used exclusively.

It was discovered that following rains a small quantity of water remained in the horizontal star-strut members due to the way they were placed. Holes were accordingly drilled in the outstanding legs of these angles.

The tower steel was painted with one coat of red lead before leaving the shop. This coat was made intact after erection, and when the bolting was completed, all bolt heads and nuts were painted with red lead in this retouching. As soon as this coat had dried a coat of dark-green lead-and-zinc paint, of very thick consistency, was applied and rubbed well into the joints and crevices. A final coat was also of dark olive green lead-and-zinc paint, but somewhat thinner in consistency and with a more glossy finish.

The antennæ were raised into position on Apr. 2, 1915, without accident. The greatest deflection of the top of the tower which could be noted with a transit was about 4 in. during the raising of the mat. This deflection was reduced to 2 in. when the hoisting stopped.

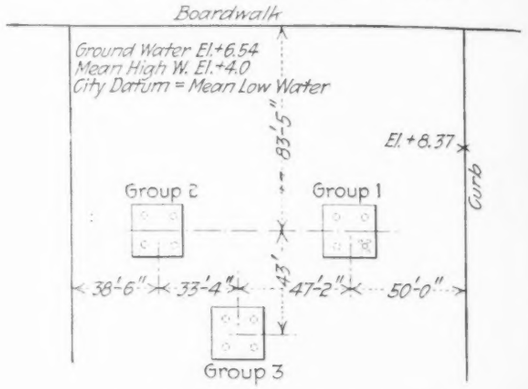
Painting Safety Lines on Pavements for the guidance of traffic is being tried in New York City. At the Fifth Ave. crossings at 34th and 42nd St. safety lanes have been painted on the pavement to indicate the proper place of crossing for pedestrians. The practice has proved successful in some other cities, notably in the downtown district of Detroit. At sharp curves on a new road opened for traffic down the steep slope of the Palisades from Englewood Cliff, N. J., on June 17, lines have been painted to indicate the safe zone for traffic in each direction.

Tests of Piles in Sand Beach, Atlantic City, N. J.

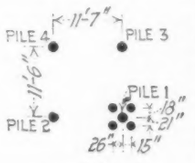
By Fred W. Abbott*

The ground formation at Atlantic City is a clean-sand bed, interlaid with clayey streaks and thin beds of clayey sand to a depth of 400 ft., where it overlays the great diatom clay bed of the Atlantic Coast plain. The lighter structures (the vast majority) are founded directly on the sand at, or near, the water line. When piles are used they are usually the commercial "Jersey" pile, about 15

PILE TESTS. PLANS OF TEST GROUPS

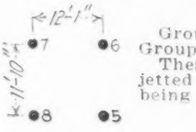


All piles were Jersey pine, driven with the bark on.



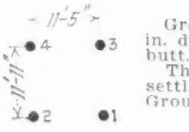
Group 1—4 piles, 32 ft. long, averaging 8 in. diam. at the point and 11½ in. diam. at the butt.

These piles were water-jetted to place and settled by drop hammer. The four supplementary piles around pile No. 1 were of the same size and penetration as the others and were driven in the same manner, but were cut off at the ground line and carried no load. They were driven subsequent to the driving of pile No. 1.



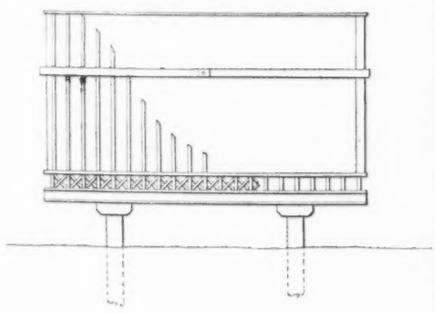
Group 2—4 piles, same size as those of Group 1.

These piles were entirely water driven, being jetted to place, subsequent hammer settlement being omitted.



Group 3—4 piles, 18 ft. long, averaging 6½ in. diam. at the point and 8⅝ in. diam. at the butt.

These piles were water-jetted to place and settled by drop hammer as were the piles of Group 1.



Elevation of Load Box—Inside dimensions of box, 20 x 20 x 10 ft. Settlements were read directly off the head of the pile. On the pile head and under the bolster was placed a steel plate on which rested a loose iron pipe passing free through a hole in the bolster and through an open box in the interior of the load box.

Fig. 1. Layout of Pile Groups Tested on Atlantic City Beach

ft. in length, waterjetted to place. Data as to the dependable value of such foundations are meager and the herein-described tests were performed to supply in a measure information desired in the design of a contemplated lofty building. They were made in a vacant lot immediately adjoining the boardwalk.

*7438 Devon St., Mt. Airy, Philadelphia, Penn.

In laying out the tests it was planned to drive three groups of four piles each, two groups of 30-ft. piles, of varied treatment in driving, to be loaded with 100,000 lb. each, approximately twice the contemplated working load for such piles, and a third group of 15-ft. piles to be loaded to failure.

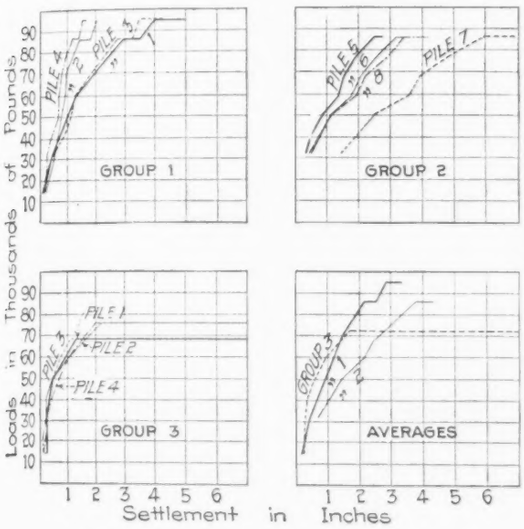
After the piles were driven and cut off to a level they were bolstered and capped with double steel-beam stringers and a box with inside dimensions of 20x20 ft. and 10 ft. deep was erected thereon. The test load was applied by filling the box with sand.

In all cases the surface was leveled off around the pile groups, for a space of about 30x30 ft., at the ground-water level. Instrument readings were taken directly off the pile heads, the box and load being arranged to make this possible, and settlements were noted on the application of each foot in depth of sand load.

Four supplementary piles were driven in close proximity to Pile 1. They were the same size and were driven (jetted and hammered) in the same manner as the other four, and were driven subsequent to the driving of Pile 1. They were cut off at the surface and carried no load, their purpose being to show what influence, if any, the waterjetting of piles in close proximity had on those previously driven. The driving of these piles raised the nearby pile ¼ in.

This group was loaded with a total of 95,000 lb. per pile, including the weight of the box.

The extreme settlement noted was from 1.75 to 5.00 in., the average being 3.28 in. At a load of 86,000 lb. per pile there was an average increase of settlement of 0.42 in. over night. At the extreme load there was an average increase of 0.28 in. over night. Three days later a further average increase of 0.22 in. was noted, at which point settlement practically ceased.



	Group					Group 2					Group 3				
Pile No.	1	2	3	4	Av'g.	5	6	7	8	Av'g.	1	2	3	4	Av'g.
Penetration in feet	30.2	30.2	30.2	30.7		29.3	27.7	29.4	29.1		15.1	15.2	15.7	15.7	
Area of surface, sq.ft.	72.5	75.5	81.0	83.0							30.3	30.1	32.7	30.5	
Area of point, sq.ft.	0.33	0.37	0.42	0.40							0.23	0.21	0.287	0.23	
Load, lb.															
14,000											(a)0.19	0.19	0.13	0.13	0.16
14,000	0.13	0.19	0.13	0.06	0.13						0.25	0.25	0.13	0.13	0.19
23,000	0.31	0.38	0.25	0.25	0.30						0.25	0.25	0.13	0.25	0.22
32,000	0.44	0.44	0.50	0.25	0.41	0.31	0.50	1.44	0.44	0.67	0.25	0.25	0.25	0.25	0.25
41,000	0.69	0.63	0.88	0.44	0.66	0.50	0.81	2.00	0.81	1.03	0.38	0.25	0.25	0.44	0.33
50,000	1.00	0.75	1.13	0.69	0.89	0.88	1.13	2.5	1.13	1.41	0.50	0.50	0.50	0.63	0.53
59,000	1.31	0.88	1.38	0.69	1.06	1.38	1.80	3.59	1.94	2.09	0.88	0.94	0.75	1.00	0.89
68,000	1.88	0.94	1.81	0.81	1.36	1.56	2.06	3.94	2.25	2.45	1.31	1.69	1.13	1.56	1.42
68,000											Failure		Failure		
76,000												Failure		Failure	
77,000	2.38	1.19	2.25	0.94	1.69	1.94	2.56	4.81	2.94	3.06					
86,000	2.94	1.44	2.75	1.19	2.08	2.5	3.19	6.0	3.44	3.78					
86,000	(b)3.5	1.81	3.25	1.44	2.5	2.75	3.44	6.88	4.13	4.30					
86,000						(c)2.75	3.44	6.88	4.13	4.30					
95,000	4.0	2.06	3.5	1.56	2.78										
95,000	4.56	2.13	4.0	1.56	3.06										
95,000	(d)5.0	2.13	4.25	1.75	3.28										

Settlement in Inches

(a) 4-day interval between 14,000-lb. load. (b) 1-day interval. (c) 7-day interval. (d) 3-day interval.

DATA ON TESTS OF PILES IN SAND BEACH, ATLANTIC CITY, N. J.; GIVING SETTLEMENT OF PILES GRAPHICALLY AND NUMERICALLY

GROUP NO. 1

Group No. 1 consisted of four 32-ft. piles, waterjetted to place and firmly settled under the blows of a hammer. It was expected that the hammer blows would compact the sand in juxtaposition to the pile, putting it at once in a condition of active resistance, and reduce the settlement under working load to within allowable limits. The hammer used (1200 lb.) was too light for this size and weight of pile and the desired result was not entirely achieved. It is believed that a heavier hammer with less fall would have given better results. These piles were driven to a penetration of 30 ft. The jet used gave 30-lb. gage pressure at the surface.

At a depth of 28 ft. a thin membrane, 1 to 2 in. in thickness, of tough blue clay was encountered, below which the jet was not effective; and the last 2 ft. of penetration was effected only with the assistance of the hammer. The hammer records show that Piles 1, 2 and 4 received an average of 19 blows, with a fall of from 4 to 15 ft., the last five blows, with a 10-ft. fall, gaining only 1 in. The number of hammer blows seems to have had no influence on subsequent settlement of the pile, Pile 1 (18 blows) and Pile 3 (127 blows) settling practically the same amount.

GROUP NO. 2

Group No. 2 included four piles of the same dimensions as those of Group 1. They were driven with the waterjet alone, subsequent hammering being omitted, the object being to determine by comparison with Group 1 the value of the final hammering. As before mentioned, the waterjet was found to be ineffective below the clay sheet at the depth of 28 ft., and these piles were therefore jetted to this depth only, their points resting approximately on the membrane of clay.

This group was loaded with a total of 86,000 lb. per pile.

The extreme settlement noted was from 2.75 to 6.88 in., the average being 4.30 in. At the final load there was an increase in average settlement of 0.52 in. during the first week after loading. Readings one week later showed no further movement.

GROUP NO. 3

Group No. 3 comprised four 18-ft. piles, waterjetted to place and hammered. They were jetted to a penetration of 15 ft. and received an average of 13 blows each of a 1200-lb. hammer with a 10-ft. fall. The hammer blows

settled the piles an average of 7 in. to practical refusal, the last three blows gaining nothing.

The settlement of these piles was quite uniform and was less in amount than that of the other groups up to the point of failure. Failure occurred under an average load of 72,000 lb. per pile. The failure was most positive. At the time the layer of sand then being placed in the load box extended over Piles 2 and 4 and about half way across the box toward Piles 1 and 3, there being, as near as can be estimated, 76,000 lb. each on Pile 2 and on Pile 4 and 68,000 lb. each on Pile 1 and on Pile 3. Pile 2 seemed to start first, followed instantly by Piles 4, 1 and 3, all piles being immediately in motion. The greater part of the settlement occurred in a few seconds, but the movement continued for about 10 min., and until the structure of the load box rested upon the surface.

Settlements are tabulated and graphically compared in Fig. 2.

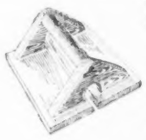
NOTES

Scaffold for Painting Railway-Crossing Signs—A light movable platform, or scaffold, devised by a foreman of the Nickel Plate R.R. has considerably reduced the cost of repainting railway-crossing signs. The platform is 8 ft. long and is held in place at any height by a simple wedge. The frame is of 2x6's surfaced on four sides and the floor is 1x6 boards and is about 24 in. wide. The 2x6 cantilever arms are fastened together a trifle over 8 in. apart. These arms are held to the post by a piece of 2x6 protected by a steel plate in front of the signpost and a ½-in. bolt behind the post. Between the bolt and the post an oak wedge is driven. To prevent wear on the sides of the cantilever arms they are protected at the post by thin steel plates. A stepladder is required to mount the platform. A smaller platform of similar design is used to paint "no-trespass" and like signs. The whole outfit may be knocked down and carried from place to place on a railway velocipede. To erect the platform it is held with its outstanding legs about the post, the bolt inserted, the platform raised to any desired height and the wedge driven.

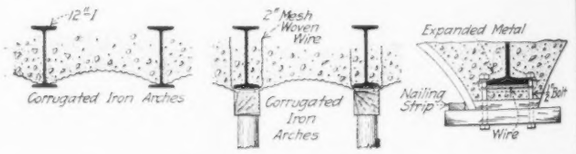
Crossing Signs Scaffold

Recovering Tools Lost in Well-Drilling—The first step in recovering a tool lost while drilling a well is to learn the shape of its upper end and the position in which it lies in the well. This knowledge may be obtained by lowering over the tool a sheet-iron vessel containing soap or other soft material for making an impression. Another scheme of location is to reflect a light from a mirror into the well. A third is by means of a photographic device, consisting of a stereoscopic photographic apparatus, which is lowered to a point near the lost tool, light for the negative being furnished by an electric current carried by wires arranged in the camera. If the drill is lost in the well, but is not jammed tight, it may be possible to lower a spudding spear and prod the top of the drill loose from the wall. The drill may then be grasped and removed by a slip socket suspended by a light string. If the tool has fallen only a short distance it may be removed by a horn socket, which when jammed over the fallen tool obtains a friction grip. Sometimes a powerful electromagnet is used for fishing, but the rigging of this apparatus is expensive and its use is difficult. In the case of a cable break, the rope can often be withdrawn by catching it with a rope spear, a rod armed with upward-pointing barbs. In dealing with defective casing it is sometimes necessary to remove it in short sections. This is accomplished by means of a casing cutter having expanding knives. When only slightly bent the casing may be straightened by the use of a pipe swedge dropped into it repeatedly. If these methods, which are described by Frederick G. Clapp in a report to Dr. Eugene Haanel, Canadian Department of Mines, prove ineffective in removing the broken or lost parts, the driller usually shifts his outfit a few inches to one side and redrills and enlarges the hole.

Split Float for Finishing Joints in Concrete Pavements—The accompanying illustration shows a special float by the use of which it is possible to obtain an exceptionally good joint in concrete pavements. This type of finishing float was used successfully during the fall of 1914 on 25,000 sq.yd. of Ohio State Highway Department work on a pavement between Ashtabula and Jefferson. The filler used was asphaltic felt, ¼ in. thick, as specified in the new specifications of the American Concrete Institute. The felt was cut sufficiently wide to extend not only through the entire thickness of the concrete but well above the finished surface. By the use of the split floats the concrete was carefully finished to the same elevation on both sides and close against the joint filler. When the concrete had hardened the surplus filler was cut away with an adz to about ½ in. above the pavement, the remainder being left to be ironed down by traffic.



Three Ways of Concreting the Arches between I-beams to form the floor of a highway bridge are shown herewith. Fig. 1 is the old way, now generally abandoned, of arching a piece of corrugated iron across the space between the I-beam flanges and filling in concrete behind these arches. This practice is objectionable for several reasons: It leaves the bottoms of the I-beams exposed, the corrugated-iron forms are lost, and remain with the under side exposed. To get around these difficulties, Willis Whited, Bridge Engineer of the Pennsylvania State Highway Department, uses the method of construction shown in Fig. 2. Under each I-beam is a stringer or centering, and the corrugated-iron arch forms



Three Ways of Concreting Arches between I-Beams of Bridge Floor

are laid on these centers; a loop of 2-in. mesh woven wire is made under and around each I-beam and the concrete placed. When the centers are removed the corrugated-iron forms are recovered. Fig. 3 is another means of accomplishing the same result, as practiced by the Connecticut State Highway Department under Charles J. Bennett, Commissioner. Here the I-beams themselves are made to support the centering. As often as necessary ½-in. bolts are placed to carry a board hung 1½ in. below the bottoms of the I-beams. The bolts are tied together with a loop of wire and are held in place as shown by 2½-in. round washers, overlapping the I-beam flanges; the nut ends of the bolts are up. Expanded-metal reinforcement is placed around the I-beam flanges. When the concrete has sufficiently set the bolts are screwed out of the nuts, the centers recovered, and only the nuts are lost. The bolt holes are plugged with concrete. No falsework is required.

Clearing Slides from Railway Cuts—During the recent heavy rainstorms around Kansas City, Mo., the Kansas City, Clay County & St. Joseph Ry. (an electric high-speed interurban line) suffered seriously from slides in the cuts. On the St. Joseph division train service was discontinued for three days. The company had an electrically operated American ditching machine which was put in service, and it is stated that without this the clearing of the line would have taken nearly two weeks. On the Excelsior Springs division there was a slide in a cut where the mud was 4 ft. deep. A nose plow placed on one of the snow-plow cars was used successfully in plowing out the mud and slush. In this way the track was cleared quickly and was kept clear.

Editorials

The Quality of Steel Rails and the Heat Treatment of Steel

The indictment of the quality of heavy section steel rails which was drawn by Gustav Lindenthal in his recent New York Railway Club paper, which was printed in ENGINEERING NEWS, May 27, is seconded by a correspondent in this issue in even more emphatic terms. While our correspondent prefers to sign his letter only with the nom de plume "Civil Engineer," we can say for the information of our readers that the letter is written by one of the best-known railway engineers in the United States and that the statements made may be accepted as authoritative. It is of especial interest to note the correspondent's declaration that the influence of steel-rail manufacturers with the railway companies, through financial connections, has been such that the efforts of engineers to secure improved quality in steel rails have been unavailing.

It is of course true that the charge made by Mr. Lindenthal and by our correspondent that the poor quality of rails is due to their being rolled at too high a temperature is far from being new. Twenty-five years ago it was a common saying among engineers, disgusted with the poor service of some of the heavy section rails just then coming into use, that the trouble was the rails were rolled so hot that the metal was practically squirted through the rolls.

Of course few railway engineers are expert metallurgists, and they would not attempt to specify by what detailed operations in the rolling mills the proper quality could be obtained in steel rails. Enough is known, however, as to the benefit accruing to steel from thorough working during the process of manufacture and from proper heat treatment to make it certain that very great improvement in rails should be possible.

Heat treatment of steel and its benefits have been well known to metallurgists for many years; but in most industries the demand for cheapness has been more controlling than the demand for quality, and the process has not been in extensive use commercially until within a very few years.

The remarkable possibilities of heat treatment in raising the strength and elastic limit of steel are only now beginning to be thoroughly appreciated. The automobile industry has been a great educator in this department of engineering work. In automobile design strict limits are fixed as to size and cross-section and weight of parts, and the manufacturers have been obliged to resort to heat treatment to obtain the desired strength.

Perhaps the best-known use of heat treatment in the field of railway materials is the Coffin process for treating steel axles, long in use by the Cambria Steel Company. This process consists in heating the axle to a temperature of about 850 deg. C., keeping it at this temperature for about 15 min. or so, and then quenching it in oil. After cooling, the axle is again heated to about 600 deg. C. and again cooled. The process is roughly comparable to the well-known process of hardening and tempering tool steel. By this means axles are produced having a tensile strength of 80,000 lb. per sq.in., with an elastic limit of 55,000 lb. Much higher figures are possible, of course, if, instead of treating ordinary carbon steel, alloy steels are used. Similarly, high figures should be obtainable by the application of proper heat treatment to the high-carbon steel used in rails.

We are by no means suggesting that this particular process would necessarily be applicable to steel rails. It is reasonable to believe, however, in view of the excellent quality secured in rails of light sections made 25 to 40 years ago, that with all the advancement in metallurgical knowledge since that time it should be entirely practicable at the present day to turn out rails at least as good.

Opening Another East River Tunnel

The formal opening to traffic on June 22 of the tunnel from 42nd St., New York City, under the East River to Long Island City marks the completion of an enterprise which had its origin 28 years ago. In an address at the opening of the tunnel Theodore P. Shonts, president of the Interborough Rapid Transit Co., briefly reviewed the history of the scheme.

In 1887 Walter S. Gurney and others incorporated a company to build the tunnel and later secured the backing of the late William Steinway, who was a large real-estate owner in Long Island City and interested in its horse-car lines. At that time no tunnel had been driven under either the North or East River, and the only means of transit across the East River, save by ferryboat, was the original New York and Brooklyn Bridge.

The company expended a large sum of money in securing franchises, rights-of-way, etc., and in 1892 let the contract for building the tunnel. The panic of 1893, together with a disastrous dynamite explosion, caused the bankruptcy of the contractor doing the work and brought operations to a standstill. The Steinway tunnel enterprise, as it came to be known, lay dormant for over ten years, very much as did the still earlier tunnel, then partly built, under the Hudson.

After the completion of the New York City rapid-transit system, however, August Belmont, president of the Interborough Rapid Transit Co., operating the rapid-transit lines, became interested in the important traffic possibilities in connection with this tunnel. The property was purchased by the Interborough company and its completion was undertaken. The company's franchise required that the tunnel should be completed and opened for traffic by Jan. 1, 1907; otherwise the franchise would be forfeited. The contract for the work was let to the Degnon Contracting Co. in July, 1905, with the proviso that it was to receive a large bonus if the work was com-

pleted within the time fixed by the franchise. According to Mr. Shonts, rapid progress was being made on the tunnel, and it would have been completed on time, but the city authorities arbitrarily cancelled the company's permits for the handling of explosives and for the deposit of excavated material. An appeal to the courts obliged the city to restore these privileges; but the delay thus occasioned prevented the finishing of the tunnel within the fixed-time limit, and the company was left with the completed tunnel on its hands but with no franchise for its operation.

In order to terminate the confusion as to the relative right of the investors in the tunnel company and the city, the Interborough company agreed with the city authorities, as part of the dual-system contracts for the construction and operation of the new rapid-transit system, to sell to the city the completed tunnel, representing a total investment of about $10,000,000, for the sum of $3,000,000. The line will be operated as an integral part of the new rapid-transit system.

The importance of this tunnel is likely to be far greater in the future development of the Greater City than was dreamed of by its original promoters 28 years ago. At that time business on Manhattan Island was largely concentrated at the lower end. The spread of business northward has been so rapid that at the present time 42nd St. may fairly be considered the center of gravity of Manhattan's traffic lines. The new tunnel brings a large area on Long Island, still unoccupied and available for residence and industries, within 10 to 20 minutes' ride of the Grand Central Station.

The Inventor of the Openhearth Process

The death in France on May 23 of Pierre-Emile Martin, the inventor of the openhearth process of steel manufacture, calls attention anew to the common experience that the originators of great inventions often fail to derive any benefit from them. Martin was born in 1824. His first patent on the openhearth process was taken out in July, 1865, and covered the melting of pig iron with scrap steel and iron oxide. To obtain sufficient heat for the process the regenerative gas furnace invented by Sir William Siemens was employed, and in England and the United States the openhearth process has always been called the Siemens-Martin process. On the Continent, however, it is called the Martin process. The new invention was taken up by two of the leading French steel companies, but the validity of Martin's patents was soon attacked on the ground that the invention was antedated by an experiment made by Réaumur in 1722, who produced steel in the laboratory by melting a mixture of pig iron with scrap iron and iron oxide. As Martin lacked the means to defend his patents, he was obliged after two or three years to give up his struggle for commercial success and retire to private life, and for many years he remained practically unknown to the engineering world.

In the early years of steel manufacture the Martin process was entirely eclipsed by the Bessemer process. In 1879 the invention by Thomas and Gilchrist of basic linings to furnaces made it possible to use phosphoric iron in openhearth furnaces, and gave a great impetus, in Europe particularly, to the use of the openhearth. Since that time the improved quality of the openhearth metal as compared with the bessemer has caused a steady growth of the former and a gradual reduction in the use of the bessemer system, and at the present time the output of openhearth steel in the world largely exceeds that of bessemer steel. A few years ago French engineers took steps to recognize the contribution made by Martin so many years ago to the art of steel manufacture. The French Government made him an officer of the Legion of Honor, and in 1910 the bankers of Europe gave a banquet in his honor in Paris.

Franchises and Fair Value for Ratemaking

Control over utility rates in New Jersey was recently regained by the State Board of Public Utility Commissioners when the highest state court, as noted in ENGINEERING NEWS, June 17, reversed a former decision and refused to allow a value for franchises above their cost and burden. The court as a whole filed no opinion, but Justice White gave his reasons for concurring, and the following passage from his statement is well worth repeating here:

> I suppose it must be conceded that the franchise to charge as a "reasonable rate," sufficient to yield a net profit of 8 per cent. on the value of the company's property as allowed and established respectively by the findings of the Utilities Commission in this case, is a very valuable property right. Certainly I think it is. That this valuable privilege is the company's is beyond question. That it is property is undoubted. That the law protects it against confiscation and subjects it to taxation follows as a matter of course. But that this valuable property right to charge "reasonable rates" should by virtue of its own existence have the effect of converting itself into a still more valuable property right to charge "unreasonable rates" is, of course, preposterous. Presumably the incorporators went into this public-utility business because they expected that their charter privilege to charge "reasonable rates" for the gas they were to manufacture, distribute and sell would be a valuable one, but that fact and the fact that it has become so cannot have the effect of altering the terms of the contract made with the state. . . .
>
> That the company's contract with the state to charge "reasonable rates" cannot be thus evaded is, of course, quite obvious. The plain fact is that the commercial value of the company's property right in its franchise can have no effect in fixing the rate it can charge, because by the terms of its contract with the state the stream of its franchise value arises from the spring of its right to charge "reasonable rates," and in the very nature of things no stream can rise higher than its source.

Here is a clear disposition of a claim which frequently has been made in various parts of the country. In effect it is said that franchises are property, but not "property used and useful in furnishing service," which public-utility laws now commonly specify as the basis of rates.

One Way to Advertise an Engineering School

A correspondent sends us a leaflet with the interesting heading "Why I Am An Engineer." According to the title page of this leaflet, it is issued by the University of Pittsburgh, School of Engineering.

We quote verbatim the first two answers to the question, "Why I Am An Engineer," printed in this leaflet:

> 1. Because the members of the engineering profession are well paid.
>
> The average salary of engineers 20 years after graduating from an engineering school is $10,000 per year.
>
> 2. Because the demand for good engineers is increasing faster than the supply.

The attendance at the School of Engineering at the University of Pittsburgh has more than doubled in two years, and still each graduate has from two to four positions offered him.

It is unnecessary to say to our readers that the average salary of an engineer twenty years after he graduates from an engineering school is not $10,000 per year, nor anything like it. It is possible, furthermore, to state what is the average income or salary from professional work, not of every graduate from an engineering school, but of such of those graduates as achieve enough prominence in their profession to become members of the American Society of Civil Engineers. The diagram which we published on p. 34 of ENGINEERING NEWS of Jan. 7, 1915, made up from the experience of some 4800 members of the American Society, showed that the average annual earnings of an engineer member of that society of twenty years' experience are $4892. Lest some defender of the university may raise the point that these were not all university graduates, else they would have earned more, we note further that another diagram in the same issue showed that, comparing the members of the society who were graduates with those who were non-graduates, the non-graduates of equal years of experience were receiving the larger salaries.

As most readers will recall, it has been fully shown in these columns during the last two years that these figures represent a much higher rate of earning power than the average engineer or the average engineering graduate obtains at the present time. So much in order to place the actual facts obtained by statistical investigation in contrast with the advertisement of the University of Pittsburgh.

The facts are so well known to engineers of experience that it is almost unnecessary to say that the advertisement of the University of Pittsburgh is false and misleading. The demand for good engineers is not increasing faster than the supply. On the contrary, there never has been a time during the past quarter century when so large a surplus of engineers of experience and ability found themselves without occupation because there was not enough engineering work to go around.

Perhaps it may be said in defense of the University of Pittsburgh that this is advertising, and that the purpose of advertising is to get business, and that it is often necessary to sacrifice adherence to the truth for the sake of getting "punch" into the advertisement.

If any such excuse is offered for the advertisement above quoted, it may be well to state the ethics which govern ordinary commercial advertising, which is carried on as a sordid business matter, and is not supposed to be governed by the high and altruistic principles which control the conduct of a great institution of learning.

The ethics of commercial advertising, then, is that false or misleading advertisements are not to be published. ENGINEERING NEWS, in common with other high-class journals, refuses to publish advertising which contains statements that it may know to be false or misleading. It is not meant by this, of course, that it is possible for the publisher to check up and verify the statements made by every individual advertiser concerning his goods. Any statement, however, which is contrary to well-known facts, and the tendency of which is to mislead or defraud, must be eliminated from the advertisement before publication.

This is the ethics of advertising manufactured articles, which are sold to men supposedly competent to judge for themselves and who make any necessary allowances for the enthusiasm of the advertiser and the tendency of every man to praise his own goods.

Certainly a code of ethics at least as high ought to prevail in advertising addressed to the general public. It is of course well known that advertising of this sort was long conducted on a very low standard, or none at all. Reputable newspapers used to publish huge advertisements of stock in get-rich-quick schemes, and objectionable patent medicines. In recent years a great improvement has been effected. The United States Post Office Department has stopped the circulation of such advertisements through the mails and has punished those guilty of carrying on such enterprises. This in connection with advancing standards in journalism has produced a great reform.

The harm done by advertising fraudulent enterprises, inducing the investment of hard-earned savings by those who can ill afford to lose them, has often been depicted. But is the harm any less serious when a youth is persuaded to invest years of time and to spend money, which may be borrowed, or on which his parents may be relying for support in their old age, under the illusion that merely by taking a course of study in a certain institution he will have various firms competing with one another for the privilege of securing his services and can reasonably expect to be earning a large salary in comparatively few years? Manifestly, if the statements made in the advertisement of the University of Pittsburgh were true, attendance at that institution and at every other first-class engineering school might well be doubled and quadrupled.

Possibly some one may offer the excuse for the above-quoted advertisement that securing an engineering education is so advantageous that any sort of exaggeration is justified if it will persuade boys to come to the schools. Let us pass over for the moment the ethics of doing evil that good may come and admit, just for the sake of argument, that it is an advantage for young men with the right qualifications to have the benefit of a course in engineering. It still remains true that the circulation of such advertising is bound to turn toward the engineering school a lot of students who are wholly unqualified to do good work as engineers. Indeed, there are many in the profession who believe that part of the overcrowding of the engineering profession and the number of misfits in its ranks can be traced to the zeal of the engineering schools to increase the number of their students by any means possible.

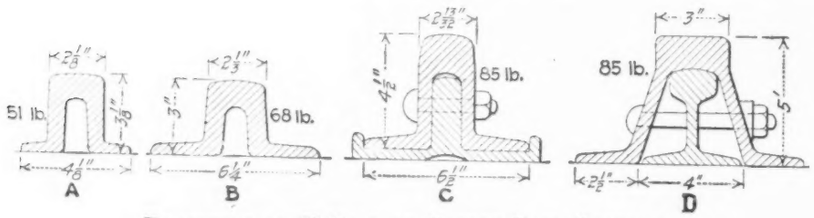
The more one reads the above-quoted advertisement, the more one is puzzled to understand how the authorities of a university of high standing could countenance its circulation. About the only reasonable and charitable explanation that we can suggest is that the work of preparing publicity matter regarding the institution must have been delegated to someone with a smattering of knowledge concerning things in general and none at all concerning engineering, and that his productions must have been sent out without supervision by someone higher in authority.

To avoid the possibility of misunderstanding by any one of our readers it may be well to add that ENGINEERING NEWS has not the slightest doubt as to the enormous value of the service which the engineering schools have rendered to the engineering profession.

Letters to the Editor

History of the U-Rail Section

Sir—Your editorial on "A New Heavy Rail Section," in ENGINEERING NEWS of May 27, mentions Brunel, the famous English engineer, as the inventor of the U-rail or bridge rail for railway track. It is quite true that he did invent this rail in England, in 1835. But he had been anticipated in this country by Strickland in 1834, who is given credit for this in Tratman's "Railway Track and Track Work." Bridge rails were used in this country on the Susquehanna & Wilmington Ry. in 1835, the Western Ry. of Massachusetts in 1840, and the Baltimore & Ohio in 1842. Those of the first line were 2½ in. high and 4 in. wide. Those of the Baltimore & Ohio were 51-lb. rails, 3⅛ in. high, 2⅛ in. wide in the head and 4⅛ in. over the base. The tendency in Strickland's designs was to increase the height in order to get a stiff rail for track laid with cross-ties. Bridge rails were used also in France and Germany in the early days of railways, but were of the broad and shallow Brunel type.



EXAMPLES OF U-RAIL OR BRIDGE-RAIL SECTIONS

A—The Strickland rail of the Baltimore & Ohio R.R., 1842 (invented 1834). B—The Brunel rail of the Great Western Ry., England (invented 1835). C—The Wrenshall rail proposed for the Northern Pacific R.R., in 1885. D—The Strobel rail, proposed in 1889

The only cases in which the bridge rail has come down to modern times are in Great Britain. The Great Western Ry. of England used the Brunel 3-in. 68-lb. rail on its broad-gage (7-ft.) and mixed-gage tracks until 1892, when the broad gage was finally abandoned. No splice bolts were used, the rail ends resting on base plates and being double spiked with screw spikes. The tracks on the Forth Bridge are laid with 115-lb. bridge rails (ENGINEERING NEWS, Sept. 9, 1909). The Central London Ry., one of the first underground "tube" lines, has 100-lb. 3½-in. bridge rails, 7 in. wide, in order to keep the height of track at a minimum (ENGINEERING NEWS, Aug. 2, 1906). In all these cases the rails were laid on longitudinal timber supports, and the height (or stiffness) of the rail was a secondary consideration.

American bridge rails have been designed for use on cross-ties, and with special regard to stiffness. In a paper on "The Improvement of Railway Track," by E. E. R. Tratman, in the *Transactions* of the American Society of Civil Engineers (March, 1890), reference is made to an 85-lb. bridge rail proposed for the Northern Pacific Ry. in 1885 by C. C. Wrenshall. This was to be 4½ in. high, 2 13/32 in. wide in the head and 6½ in. over the base, with webs ½ in. thick. The joints were to be spliced with T-shaped splice plates bolted through the webs, the edges of the plate being turned up to engage the sides of the rail base.

In the paper by Don J. Whittemore on "Cylindrical Wheels and Flat-Topped Rails," which attracted so much attention some years ago (*Transactions*, Am. Soc. C. E., 1889), the bridge rail received favorable comment, as follows: "If a change is necessary, why not have our form of rail a type of that noblest of all creatures, a level-headed man with two legs and feet to correspond? Why not come back to the design of the American, Strickland, of 1834, redesigned by Brunel in 1835 and still in use on the Great Western Railway of England?"

In the lengthy discussion of this paper George B. Hazlehurst suggested a bridge rail in which the head projected beyond the webs, in order to get a bearing for ordinary angle splice bars. An 85-lb. bridge rail section was proposed also by Charles L. Strobel; this had the webs flaring outward below the head. The splices were to be made with light T-rails or special rolled sections, and with or without the use of bolts. This rail is a combination of the bridge rail and Barlow's "saddle" rail of 1849 (England). The Barlow rail had curved flaring sides or webs and was originally intended to be packed with ballast and used without other support, but in a few cases it was spiked to cross-ties.

The accompanying drawing shows the Strickland, Brunel, Wrenshall and Strobel bridge rails.

"RAIL AND TRACK."

Chicago, June 9, 1915.

Poor Quality of Heavy Steel Rails

Sir—In ENGINEERING NEWS, May 27, 1915, you published some very interesting comments on Gustav Lindenthal's paper on "The Qualities of a Good Steel Rail," as presented at a meeting of the New York Railway Club on May 21.

It is encouraging to know that interest in this important subject is still manifested and that such an eminent authority as Mr. Lindenthal has advanced views which must compel engineers to give thought to the grave problem. In connection with this matter, the writer, over three years ago, in a discussion with the president of a prominent railroad, was asked to outline his views, in consequence of the many breakages of heavy steel rail. The inclosed article, which was then intended for private use only, was the result, and close observation since the time it was written has only accentuated the writer's opinion. It will be noted that on the very vital point of rail manufacture the writer, while perhaps going farther

than Mr. Lindenthal, sets forth substantially the same ideas.

CIVIL ENGINEER.

New York, June 3, 1915.

[The inclosure referred to follows.—EDITOR.]

The article "Making Steel Rails Better," published in the "Times" of Jan. 20, deals with a subject of grave importance to us all, and one which, apparently, has not been given the discussion and attention which it deserves. This letter is not intended in any manner as an argument against trusts, which the writer firmly believes in under proper regulation, but rather as advancing some ideas which are worthy of discussion, and which for some obvious reasons he believes have not heretofore been presented, publicly at least.

The writer advances the general proposition that provision for safety to the traveling public, as far as human intelligence can foresee, is the duty of every official to whom is confided the maintenance and operation of railways; also, that under present conditions, with the modern rail as now laid on even our best roads, wrecks, with loss of life and its consequent horrors, are ever present, not as a possibility, but as a probability.

Now, upon whom does the responsibility for this rest—the railroads or the rail manufacturers? The writer believes it to rest upon both, but largely upon the latter.

It may be safely assumed that perfect drainage of roadbeds, plenty of well-tamped ballast, sound ties and an ample amount of track labor under intelligent supervision are necessary to maintain what in railroad parlance is called "good track." This brings us up to the duty the rail and its adjuncts have to perform.

It is true, as stated by the authority which your article quotes (and high officials of the Steel Corporation have previously said the same) that weights of engines and speeds of trains have increased to a marked degree in the past few years, and therefore greater burdens have been imposed on track and rails. But it is not true in the broad sense that should characterize an honest discussion of this very important subject, that the quality of the rails has kept pace with the increased duty; quite the reverse. Apparently, about all the effort made for the improvement of rails to enable them to carry their increased burden has been to make them heavier. This increased section, as a matter of fact, makes the rails relatively weaker; but—mark this carefully—it provides a much increased tonnage, for which the railroads must pay, for a given mileage, without an adequate compensation in the way of increased safety.

Now, what is meant by this? Briefly, everything is sacrificed to haste—to get all the possible tonnage through the rolling mills in the shortest possible time; and the results are apparent in broken rails, loss of life and property, and a general uncertainty which pervades every railroad-operating office as to what is the trouble and how it can be averted.

Any one visiting a modern steel-rail mill will see the ingots, each of a size and weight sufficient to roll about 100 ft. of rail, come out of the gas furnaces heated almost to the melting point. They are picked up and sent with almost incredible speed through the rolls—back and forth; biff-bang—and in a comparatively few passes assume the form of a modern T rail. After snipping off the jagged ends, the piece is sawed into three 33-ft. rails, which go to the cooling beds to be straightened, and (God save the mark!) inspected, ready for shipment and delivery.

There is something in all this overheating and rapid rolling which our chemist friends are not alive to, or are wisely oblivious to, which is injuriously affecting the quality and strength of the rail. The writer believes that sufficient time is not given to allow the molecules to adjust and reassemble themselves as the laws of nature and chemistry demand, and that the excessive heat to which the steel is subjected tends to destroy its strength.

Under the processes of former years, to roll a steel rail required very much longer time than at present. It was not heated to such an excessive temperature—almost burned up, as now—and it was reheated several times, during or between its passage through the rolls. Thus, sufficient time was allowed apparently for the molecules of the steel to adjust themselves to their new conditions and to insure that only natural, normal strains would result. This theory may be sneered at as purely academic and theoretical, but let us take some practical examples:

A few years ago the writer was in charge of the maintenance and operation of a very busy piece of track, with severe grades and curves and carrying heavy tonnage. Modern and powerful engines were used, carrying heavy wheel loads and at fast speeds. This track was laid with rails weighing 75 lb. per yd. rolled in 1892. In 1900 some of this rail became curve-worn to the extent that it became unsafe. A lot of new 80-lb. rail, rolled in 1900, was purchased and laid in place of the old rail of 1892. In many places the new rail was laid for one rail of the track and the old rail was left on the opposite side. What was the result? In less than two years a very large proportion of the new rail had failed from breakages and wear of head and was taken out, while the old lighter rail was left, still carrying its load safely.

Many samples of both rails were taken and broken under the steam hammer so as to show the actual appearance of each, as regarded texture, etc. In every case the old rail showed a fine grain, perfectly homogeneous structure, indicating perfect crystallization and, presumably, maximum strength. In case of the new heavier rail, the showing was entirely different. The crystallization was uneven, unhomogeneous, some of it in fine crystals and some extraordinarily large, the whole cross-section looking in size and general appearance more like the back of a bull frog than a piece of steel. In the testing machine the new heavier rail showed 20 per cent. less strength than the old and lighter rail.

The writer also compared samples of this modern heavy rail and rail of 60 lb. rolled in 1886, both at the Krupp Works at Essen with some rails rolled in this country at the same time. It is hardly a stretch of the truth to say that the old 60-lb. rail was equal in strength and duty to the modern 80 lb.

The writer has discussed this matter with various railroad officials, and universally has found a disposition to admit that the quality and strength of rails are being sacrificed to speed in manufacture. Also, he has found, sad to say, a disposition to "let sleeping dogs lie," as the connection between the manufacturers of rails and the financial control of railroads was altogether too intimate.

As a matter of fact, it would be good business for any railroad company to pay $40 per ton for rails, heated to lower temperature, rolled slowly and reheated during rolling, than to pay, as now $28 per ton for the imperfect product now being forced upon the companies. Furthermore, at the average price of pig, coke, etc., for the past ten years, rails rolled properly can be made at the present price and give a fine profit to the mills. There is no service that the railroads are called upon to perform that a 90-lb. rail, made as it should be, laid on a well-kept roadbed, will not perform with comparative safety. The purchase of rails of heavier weight is a concession to ignorance and the arbitrary demands of the manufacturers of steel rails.

Steel Ties for Street Railway Track

Sir—We have read the editorial appearing in ENGINEERING NEWS of June 10 relative to selling stock in patent railway-ties companies, and we endorse it in so far as it applies to steam-railway ties.

The editorial, however, does not do justice to the steel tie in paved-street track for electric railways. Our twin steel ties were first used in 1908, and are now widely used by electric railways all over the country, as shown by the inclosed list. This tie is not only superior to wooden ties in paved-street track, but it is cheaper in first cost.

Our company is not a stock-selling proposition. We manufacture steel ties and steel crossing foundations exclusively and are doing a rapidly increasing business in these products.

INTERNATIONAL STEEL TIE CO.,
William P. Day,
Vice-President and General Manager.

Cleveland, Ohio, June 19, 1915.

[The editorial referred to related solely to ties used on steam railways, and we specifically disclaimed reference to any concern carrying on a legitimate business. The information forwarded with the above printed letter shows that the steel tie made by the company is in use on over 30 street railways and is claimed to effect a large saving in cost and maintenance over wooden ties for track in paved streets.—EDITOR.]

American Society for Testing Materials

SYNOPSIS—The annual meeting last week showed active committee work in preparing specifications for materials; 37 new or revised specifications, 11 test methods, and 3 sets of definitions were adopted. Continued interest and growth but anaemic finances resulted in increase of dues. Steps taken toward getting out new cement specifications led to bitter contention. The society declared against making specifications for engineering methods or structures.

By electing Prof. Mansfield Merriman as its new president, the American Society for Testing Materials has in one respect turned time back 17 years, to the society's date of origin. He was the first president of the organization before it seceded from the International Association for Testing Materials of Construction. Even in those days it represented a new thought—the creation of uniform or standard specifications for commonly used materials. The vitality of this idea is largely responsible for the great growth of the society and its present high rank among technical organizations.

In other respects than the choice of its president the society at its annual meeting held June 22-26, at Atlantic City, N. J., showed no turning back. Its well-fixed reputation for holding very active and stimulating meetings was maintained or even increased. There was not only the depressing influence of the European war to be figured with, but the competition of at least two other large meetings of engineers—the American Society of Mechanical Engineers (at Buffalo) and the Society for the Promotion of Engineering Education (at Ames, Iowa)—which were simultaneous with the Atlantic City meeting. Yet the attendance (489 men and 112 women) was practically equal to last year's. And, what is more to the point, the proceedings of this meeting showed a higher efficiency in the society's work than any prior one.

The last statement applies to the work of the technical committees. Nearly all of them brought in new or revised specifications, the product of research and conferences during the year. Without making comparisons as to number or variety of specifications with other years, it can be said that marked progress in securing harmony and bringing divergent views together in the committees was evident.

Two notable exceptions to the general condition of harmony formed prominent features of the meeting: (1) The cement committee, which by an unusual chain of events was confronted with concrete proposals for revolutionizing the standard cement specification, indulged in a lively fight, ended for the present by a parliamentary truce, not peace. (2) The committee on Tests for Lubricants has squabbled over the question of viscosity tests for two years and is still far from agreement; this produced a solid hour's wrangle in the meeting, until finally the society decided that the matter should be returned to the committee for another year. But these two contests, besides being highly interesting, showed efficient work on the part of the society if not of the committees concerned, since in both cases the society rejected the chance of getting an earlier result at the cost of losing the agreement of a small but strong minority. The society's past history proves that specifications for materials or for test methods can be made to suit all parties, if only the parties are locked up long enough in a committee room and left together till they recognize that their purposes are identical.

President Gibbs Criticizes Rail Specification

It may be that too much of this harmony prevailed in drawing up and revising the railway-rail specifications of the society during the past eight years. These specifications, declared Pres. A. W. Gibbs in his presidential address, contain glaring faults. Thus, as to ladle analysis:

> It is difficult to see how a specification could be made more absurd. . . . Neither the American Society for Testing Materials nor the American Railway Engineering Association specification really protects the buyer as to chemistry.

Again, as to acceptance of rails by retest if the first drop-test fails:

> We hold that this is a pernicious practice, in that the consumer has positive proof that some of the accepted material does not meet the requirements.

And, after further criticizing the clause which permits unsound rails to be accepted as "special," presumably for use in unimportant locations, he said:

> Summed up, the rail specification of our society does not put a proper premium on the selection of the better part of the ingot for one of the most exacting services for which steel is used. Where our specification differs from that of the American Railway Engineering Association it is not so good.

He followed this up by calling for constructive work in committee to "prescribe specifications and tests which, if enforced, will prevent improper material from getting into service."

It is fair to say that he also expressed the opinion that heavier rail-sections are a first requisite. And he likewise mentioned the steady increase in weights of locomotives and cars:

> In this country the answer [to the rising costs] has been operation by larger units. Tersely stated, it means heavier loads and more of them. This is a path which, once entered upon, admits of no turning back. It leads directly to the Rail Problem.

Probably no important railway man heretofore has stated so clearly the view that there will be no stopping point in the increase of train loads and axle loads.

Before referring further to the committee work and its results, we note some features of the meeting bearing vitally on the society's future.

Specifying Engineering Methods and Pipe Threads

As it is only a short step, in many cases, from prescribing materials to dictating methods of construction, so the danger always existed that the society might overstep the proper bounds of its activities by taking up engineering design or practice. Not till last year, however, did an actual case of any importance come up—the Drain Tile committee insisted on joining to its specifications for drain tile and test methods a treatise on how to lay drain tile. The strange thing is that, without deliberation

or debate, the 1914 meeting accepted this treatise and voted to adopt it as a standard.

One or two further cases came up at the present meeting. A prescription for laying sewer pipe was formulated, and the meeting accepted it among its Tentative Standards. Again, the gypsum committee asked authority to specify concerning the laying up of gypsum-block walls and the like. And again, the society set a committee to work preparing a revision of existing standards for pipe threads—surely not a material!

However, in the near future means are to be considered for keeping out of foreign fields, except perhaps as to pipe threads. Even last year the governing authorities felt that to specify methods of laying pipe was risky business, and they therefore secured authority from the meeting to consider broadly the problem of establishing limiting principles. The result was the announcement, at this year's meeting, of the rule that the society's committees should not attempt to specify engineering methods of design or construction. How this rule can be carried into practice is a problem yet to be solved.

For the present the specifications for laying drain tile and for laying pipe sewers remain among the society's standards (the latter only as a Tentative Standard), and the gypsum and pipe-thread committees are continuing their work unmodified. But the meeting gave some active discussion to the subject, which clearly showed a healthy sentiment in favor of sticking to materials *per se*.

Good Growth but Close Finances

The records presented by the secretary show a steady growth in spite of the war conditions. In fact, the number of new members admitted in the first half of 1915 exceeded prior figures, amounting to 201. The total membership is now 1842, a net increase of 155 for the year, as compared with an average annual increase of 105 in five years.

Considering the growing membership and the increasing volume of publications (1881 pages during the past year, as compared with less than 1000 five years ago), it might be expected that trouble would develop from the low membership dues ($10). The secretary reported, in fact, that each member cost $10.79 during the year, so that a deficit is being accumulated.

Membership Dues Increased

The Executive Committee studied both sides of the question—cutting expenses and raising the income—and finally recommended that curtailment was inadvisable but that the income ought to be increased. Various means to this end were proposed by the committee. Its last and most radical proposal was a flat 50% increase in the annual dues of juniors ($5 to $7.50) and members ($10 to $15), as well as in the fee for membership-in-perpetuity of firms and corporations ($200 to $300). When this was laid before the meeting by Vice-Pres. A. A. Stevenson, discussion was not needed or requested, but the meeting voted solid and strong in favor of the increase—subject to ratification by letter-ballot.

New Officers Elected

The selections for officers by the nominating committee were ratified by the society's vote. They are: President, Mansfield Merriman, New York, N. Y.; Vice-President, Gen. W. H. Bixby, Washington, D. C.; members of Executive Committee, J. H. Gibboney (Roanoke, Va.), Prof. W. K. Hatt (Lafayette, Ind.), J. A. Mathews (Syracuse, N. Y.) and Prof. Edward Orton, Jr. (Columbus, Ohio).

The work done by the society's committees in preparing and revising specifications is hardly more important than their research and study work. Some of this appears in papers contributed by individual members of committees, while the rest is largely embalmed in appendixes to the committee reports. We will mention some of the most interesting items of committee research after noting the specifications adopted.

The independent papers presented at the meeting will be reviewed in brief abstract in coming issues, in so far as they bring forward new facts or arguments necessary to the engineer in his work.

New and Revised Specifications

The following list gives the subjects of the new and revised specifications, test methods, and codes of definitions which the meeting passed upon. The last-named are a new thing in the society's work, originating in the fact that many terms used in specifications did not have a single and unquestioned meaning as generally employed. Three sets of definitions were adopted this year, and more are in preparation.

Reference is made in the list to dates of the original specifications revised, and to joint action with committees of other societies.

SPECIFICATIONS

Brackets indicate those accepted as "Tentative" only

For iron and steel chain.*

For malleable-iron castings (revised from 1904 standard).

[For foundry coke.]†

[For bare concentric-lay copper cable; hard, medium-hard or soft.]‡

[For high-strength bronze trolley wire, round and grooved; 40% and 65% conductivity.]

For hard-drawn copper wire.§
For medium hard-drawn copper wire.
For soft or annealed copper wire.
} Revised from 1913 standards to omit reference to cable or strand, and by changing "surface imperfections" to "imperfections."

[For the alloy: Copper 88%, tin 10%, zinc 2%.]

For quenched high-carbon-steel splice bars.

For quenched carbon-steel track bolts.

For quenched alloy-steel track bolts.

For lap-welded and seamless boiler tubes for stationary service.‖

For welded steel and wrought-iron pipe.‖

For structural steel for bridges (revised from 1914 standard by providing for unannealed specimen tests of eyebar material.)

For automobile carbon and alloy steels (revised from 1914 standard).

[For carbon-steel bars for vehicle and automobile springs.]

[For silico-manganese-steel bars for automobile and railway springs.]

[For chrome-vanadium-steel bars for automobile and railway springs.]

[For helical and elliptical springs for railways.]

[For alloy-steel forgings.]

[For quenched-and-tempered alloy-steel axles, shafts and other forgings for locomotives and cars.]

For cold-drawn steel openhearth automatic screw stock (printed as tentative in 1914).

For paving brick.**

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*With partial coöperation of a committee of the American Railway Association. The specifications differ slightly from those of the Master Car Builders' Association.

†Includes methods of sampling, and will include methods of analyzing coke, the latter to be formulated jointly with committees of the American Foundrymen's Association and the American Chemical Society.

‡Prepared jointly with the Standards Committee of the American Institute of Electrical Engineers.

§This was under joint consideration with the Power Committee of the American Electric Railway Engineering Association, but agreement could not be reached.

‖Cover iron as well as steel tube and pipe. The specifications were drafted jointly with the wrought-iron committee.

**Includes methods of test.

[For the laying of sewer pipe.]

For quicklime. } Printed as tentative in 1914; the present
For hydrated lime. } form contains many changes and is essentially new.

For purity of raw linseed oil from North American seed (revised from 1913 standard).

For purity of raw Chinese wood oil.

For purity of boiled linseed oil from North American seed.

For turpentine.*

For classification of structural timber (revised from 1907 standard).

For yellow-pine bridge and trestle timbers (revised from 1910 standard).

[For Southern yellow-pine piles and poles to be creosoted.]

[For Southern yellow-pine timber to be creosoted.]

For cotton rubber-lined fire hose for private department use.

[For insulated wire, 30% rubber insulation.]

METHODS FOR TEST OR SAMPLING

Brackets indicate those accepted as "Tentative" only.

[For sampling and analysis of pig and cast iron.]

[For the sampling of coal.]

[For the laboratory sampling and analysis of coal.]†

For chemical analysis of alloy steels.

For testing.‡

[For routine analysis of white pigments.]

[For distillation test of paint thinners other than turpentine.]

[For determination of moisture in bleached shellac.]

[For sampling and analysis of creosote oil.]

For test for cotton rubber-lined hose.

[For the testing of automobile tire fabrics.]

DEFINITIONS

Of terms relating to sewer pipe.

Of terms used in paint specifications.

Of terms applicable to materials relating to roads and pavements.

Copper Wire

During the past year disagreement of Committee B-1 with the Power committee of the American Electric Railway Engineering Association developed on the subject of including the twist test. The latter insisted on including such a test, and no agreement could be reached. Cooperation therefore terminated, and Committee B-1 reported no revision of its specifications for hard-drawn copper wire. It fortified its case by an inquiry among electric railways, which showed that many are using the specifications.

Government Bronze (88-10-2)

In considering the new specifications for 88-10-2 bronze some opposition developed. The specifications of the committee (Chairman Wm. Campbell, New York) set the range of composition at copper 86-89%, tin 8-11%, zinc 1-3%. G. H. Clamer of Philadelphia demanded a higher copper content (88-90%) with reduction of the tin range. No support was given to this, but it led to the acceptance of the specification as "Tentative" instead of "Standard," so that argument on the matter can continue.

Steel

The smooth way in which the recommendations of the Steel committee (Chairman C. D. Young, Altoona, Penn.) went through was a notable feature of the meeting. Apart from a slight argument on spring steel the dozen or more new specifications brought in by the committee were accepted by the meeting in routine style. It is true, of course, that steel rails, always a sore theme, were not involved. A dispute at last year's meeting over axle specifications, voicing the opposition of representatives of the American Electric Railway Engineering Association, has been cleared away by the withdrawal of these representatives from joint action.

The moment the specifications were disposed of, however, the rail subject bobbed up, and there was an argument, as noted farther on.

Methods of Physical Testing

The long labors of the committee on Standard Methods of Testing (Chairman G. Lanza, Philadelphia, Penn.) were rewarded at last year's meeting by a rejection of the revised specifications brought in. Practically the same thing happened this year, inasmuch as vital parts of the specifications were accepted only as "Tentative." The chief trouble arose over the committee specifying three-point attachment of extensometers, and stopping the machine to take readings, in getting the modulus of elasticity. Men from both mill and college testing laboratories joined in opposing these practices, which showed that the committee in trying to prescribe for both commercial and research testing in a single specification failed to satisfy either party. Other opposition related to definitions proposed by the committee for elastic limit, proportional limit, and yield-point, and methods for determining them.

T. D. Lynch (Westinghouse E. & M. Co.), Prof. H. F. Moore (University of Illinois) and others declared that two-point extensometers and continuous running of the machine give reliable results. Prof. G. Lanza insisted that only a three-point instrument with three separate readings (not mechanically averaged) would reveal a curved condition of the specimen. Mont Schuyler (St. Louis municipal laboratory) claimed that lateral motion of the head of the testing machine might neutralize attempts at centering a specimen, to the extent of requiring three-point instruments to show whether the pull is central. Prof. H. F. Moore objected to specifying three-point measurement for research tests because the investigator would use any method suited to his purpose; in certain recent tests at the University of Illinois extensometers have been used on 46 gage-lines, the results showing among other things that transverse planes do not remain planes during the test.

It is expected that further work of the committee will be directed toward working out specifications for a definite field of use.

Lime Inspection

The Lime committee's specifications for quicklime and hydrated lime were opposed by W. C. Hanna (Calif. Port. Cem. Co., Colton, Calif.) on the ground that the inspector has no business in the whole lime plant but should be limited to the shipping room; special methods of the plant might become known to competitors through the inspector. The meeting did not take the same view.

Viscosity Measurements for Lubricants

The burning question whether the Engler viscosimeter is better than the Saybolt and whether either of them merits the distinction of being made the standard of the society has kept the lubricants committee stirred up for two years. Last year the society declined to settle the matter and referred the dispute back to the committee; this year it did the same. The majority

*Covers both gum spirits and wood turpentine.

†Prepared by a joint committee of the American Chemical Society and the American Society for Testing Materials.

‡Two sections were accepted as merely tentative. They deal with three-point extensometers and with definitions of elastic limit.

of the committee preferred the Saybolt instrument last year, but the opposition of the Bureau of Standards carried the day. Since then the Bureau made careful studies of viscosimeters and dropped its opposition, besides drawing up factor tables for converting the readings of one instrument into those of the other. But other members of the committee continued their opposition, and brought minority reports before the meeting. The meeting devoted a great amount of time to hearing the dispute, which went so far as to question the propriety of specifying a type of instrument by name. The verdict on the dispute was that the committee should adjust its differences during another year's consideration.

"Dense" and "Sound" Pine

Classifying southern-pine timber into long-leaf, short-leaf, etc., proved to be unworkable for commercial grading and buying, as the material from the different pines intergrades more or less. The Forest Service during the past year studied the relation between rings per inch, percentage of summer wood, strength, etc. From the results of this study a grading classification of distinct novelty has been developed. In the form as drafted by the committee and accepted by the meeting for letter-ballot, there are two classes, either of which may include long-leaf, short-leaf, loblolly, Cuban, and pond pine:

Dense Southern yellow pine shall show on either end an average of at least 6 annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth, and fifth inches on a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

Sound Southern yellow pine shall include pieces of Southern pine without any ring or summer wood requirement.

Two elaborate papers, "Discussion of the Proposed Forest Service Rules for Grading the Strength of Southern Pine Structural Timbers," by H. S. Betts, and "Southern Yellow-Pine Timber and Density Grading Rules," by O. T. Swan, supported these recommendations.

Committee Research

Of the extensive research work done by the various committees, only a few notes can be given. Specially comprehensive investigations have been or are being made by the committees on Steel, Cement, Concrete Aggregates, and Paint. A few individual items are reviewed here.

Studies of Rail Shrinkage

Pyrometer studies of rails in rolling mills made by the Bureau of Standards during the past year showed that the shrinkage clause in rail specifications does not and can not insure that the final rolling will be done cool enough to give good metal structure.

Criticism of the society's specification was so distasteful to the rail subcommittee that it undertook a defense of the shrinkage clause. The subcommittee presented a very elaborate study, published as an appendix to the Steel committee report. It proves even more than might have been anticipated, namely that the finishing temperature has no relation to the service value of the rail. Partly for this reason the subcommittee concludes that

it seems hardly justifiable to go to any great expense in determining finishing temperatures any more accurately than is possible with the shrinkage clause, which on account of its easy application is by far the most convenient means of checking the finishing temperature.

G. K. Burgess, of the Bureau of Standards, after presenting a destructive detailed review of the report, pointed out that the subcommittee itself declares the finishing temperature to show no service relations, hence finds the shrinkage clause meaningless, but insists on retaining it in the specification. Further, the specified shrinkage allowances permit 100-lb. rails to be finished at a temperature 60° C. higher than 75-lb. rails; is this a manufacturing convenience or a necessary limitation for efficiency in service? In reply E. F. Kenney (Johnstown, Penn.) defended the shrinkage clause as a heritage, and opposed with the following argument Burgess' proposal to use pyrometric control: Between making more difficult a feature of doubtful value (control of finishing temperature) and throwing it out entirely, a middle course is possible, namely retaining the doubtful feature in its simplest form.

However, the Steel committee voted, Chairman Young announced, to consider seriously the matter of accepting Mr. Burgess' coöperation.

Final Report on the Havre de Grace Bridge Paint Test

Though the large-scale comparative test of bridge paints on the Havre de Grace bridge of the Pennsylvania R.R. was ended more than a year ago, no general report on the test was then rendered, and the Paint committee had to be instructed specifically by the society to make such report. An excellent report was therefore brought in this year. It describes the various paints as to composition, and in a sane and useful way states their performance. The painters' log-sheets are also reproduced, to supply information on conditions which affected the application of the paint.

The net result of the test—so the report impresses the reader—is to show that most of the 19 paints had a surprisingly long life, that paints of nearly all varieties can give good and long-time protection, and that the virtue of a red-lead addition is unmistakable.

Another important exposure test was also finally reported—the Atlantic City steel-and-iron plate test of paints made to show whether a classification by the Thompson water test into so-called "inhibitors" and "stimulators" has any meaning. The subcommittee which reported could find no meaning, but evaded any direct statement with the recommendation that further tests be undertaken.

The cyclopedic work of the Paint committee on analysis and normalization of paint-oils continues with undiminished energy. Most of the oil and paint laboratories in the country are participating in this work. As the list of specifications indicates, the work has already been brought to a fair conclusion as to turpentine, several kinds of linseed oil, and raw Chinese wood oil.

Cement and Concrete

Committee activities in the concrete field were restricted this year to the consideration of the constituent materials of concrete and did not consider the finished concrete. Committees have evidently come to the belated conclusion that the trouble with concrete, where it is in trouble, is not owing so much to a lack of appreciation of

the qualities of the finished product as to an ignorance of its ingredients, an ignorance more than surprising in view of the amount of concrete and the long experience in its use.

Committee C-1 on Standard Specifications for Cement, George F. Swain, chairman, reported on four of its subsidiary activities—the Joint Conference on Uniform Tests and Standard Specifications for Cement, the autoclave test, the standard screen scale and the Chapman consistency test. The report was accepted as read with no discussion.

Cement Specification

In March, 1912, Committee C-1 adopted the following resolution:

> In order to secure uniformity in specifications for cement, it is recommended that the Board of Direction of the American Society of Civil Engineers, the Committee on Standard Specifications for Cement of the American Society for Testing Materials, and the Government Departmental Committee on Specifications for Cement be each requested to appoint a committee of three to confer for the purpose of reconciling differences.

In pursuance of this resolution on Oct. 24, 1912, the Joint Conference on Uniform Methods of Test and Standard Specifications for Cement was organized with nine* members. The conference has conducted investigations and inquiries of various kinds, and reached an agreement on Apr. 28, 1915, in all matters except the method for the determination of time of setting. The report of the conference, a document of over a hundred pages, was mailed to the members of Committee C-1 on June 5, 1915. At a meeting on June 23, 1915, Committee C-1 adopted the following motion:

> It is moved that the report of the Joint Conference be received and referred to suitable subcommittees of Committee C-1 to investigate and report in not later than one year; said subcommittees to be appointed by the Advisory Committee and approved by Committee C-1.
>
> It is further moved that the Executive Committee of the American Society for Testing Materials be asked to confer with the Board of Direction of the American Society of Civil Engineers and to suggest that they withhold from general publication the Joint Conference report until this committee (C-1) has had a sufficient opportunity (not longer than one year) to consider the report.

It will be remembered that the Joint Conference was called into being primarily to reconcile the differences in the standard cement specification of the American Society for Testing Materials (adopted in 1904 and revised slightly in 1908 and 1909) and the specification used in the purchase of all cement by the Federal Government (signed by the President in 1912). The American Society of Civil Engineers was a party to the conference because that society is the author of the standard method of testing cement always considered as a part of the Am. Soc. T. M. specification. The difference between the two standard specifications is mainly in wording, arrangement and in the test for time of set. In the minds of some members of Committee C-1 the sole function of the Joint Conference was to reconcile *these* differences. Apparently the members of the conference have a different view, for the work of two years and eight months has ranged over the whole field of cement and its testing and the recent report (available only to members of the committee) is a résumé of the results of such an investigation together with a suggested standard specification differing—rather radically in some details—from either of the two originally under consideration. The peculiar resolutions adopted first by the committee and later accepted by the meeting are the result of a feeling on the part of a bare majority of the committee that the report and the proposed specifications should not be made public until the manufacturers of cement have had time to study the report and to submit criticisms of both report and specification. It is of course a matter of debate in just what degree the wishes and opinions of Committee C-1 can be imposed on the American Society of Civil Engineers or on the engineers representing the Federal Government in the conference.

Autoclave Test

The subcommittee on the autoclave recommended that "the autoclave test for soundness should not for the present be adopted for the reason that the investigations which have been made of this method do not show that it is in any way superior to the present test for soundness." The subcommittee on a standard screen scale reported that in accordance with a decision of the Executive Committee of the society no further action should be taken on this question. The subcommittee to investigate the Chapman consistency test reported that "the apparatus when operated in accordance with the method recommended by the inventor does not give sufficiently concordant results on 1:3 cement-sand mortars or on neat cement paste to warrant recommending its use as a reliable test for consistency."

Concrete Aggregates

The Committee C-9 on Standard Tests for Concrete and Concrete Aggregates (Sanford E. Thompson, chairman) has outlined a most elaborate series of tests which is now under way, the tests themselves for the most part being made in various commercial and college laboratories. Work is being carried on in coöperation with the Committee on Specifications and Methods of Tests for Concrete Materials, of the American Concrete Institute.

Subcommittees have been appointed, each to direct the investigations into one particular branch of the general subject. There is no better method of conveying the extent of the program than by abstracting the work of each subcommittee as given in the main committee report:

> Laboratory Tests for Concrete and Laws of Mechanical Mixtures.—This subcommittee has outlined certain tests on concrete and mortars with the view of establishing the best practice in making and testing concrete specimens in the laboratory and to determine the effect of variations in the gradation of sizes of the aggregates on the strength and properties of the concrete. These tests cover a wide range and necessitate the making and testing of a large number of specimens. It is felt that only by making such tests exhaustive can information be obtained which will permit the drawing of definite conclusions. It is hoped that these tests will furnish information upon which can be based definite recommendations as to the practices which should be followed in testing concrete in the laboratory; and it is also hoped that definite conclusions can be reached as to the effects of certain variations in the gradation of the sizes of the aggregate materials. The following series of tests have been outlined as a part of the necessary investigations:
>
> 1. Comparison of metal and wood forms for standard laboratory tests of concrete. 2. Variations in strength and properties of concrete throughout the batch. 3. Effect of different methods of tamping and compacting. 4. Effect of condition of storage of specimens for standard compression test of concrete. 5. Method of capping test specimens preparatory to testing. 6. Effect of gradation of sand. 7. Effect of varying ratio of fine to coarse aggregates. 8. Effect of varying sizes of fine to coarse aggregates. 9. Strength of mortar as affected by the form of the test specimens.

*Alfred Noble, one of the American Society of Civil Engineers' members, died Apr. 19, 1914, and his place was not filled.

Sampling and Testing Field Concrete.—In laying out the work for this subcommittee it was found that on a number of the larger concrete jobs field tests are being made, but there seems to be no uniformity of practice in making, storing and testing the specimens. It was deemed wise, therefore, that this subcommittee select tentatively a method which seems to have the most merit and recommend that wherever possible such tests be made. The following tests have been outlined:

1. Comparison of four methods of storage during first two days after molding. 2. Comparison of methods of storage subsequent to first two days. 3. Study of the cold-weather effect on field specimens. 4. Comparison of prisms made in the field and in the laboratory with prisms cut from work. 5. It is considered within the realm of possibility that a portable core drill can be made to use in cutting test specimens from concrete already in place in the form of 6x12- or 8x16-in. cylinders.

Relative Values of Various Strength Tests.—In the field to be covered by this subcommittee there are certain fundamental problems which it is felt should be investigated as soon as possible. These may be stated as follows:

1. To establish the relative reliability of mortar strength tests for determining the suitability of sand for use in concrete. 2. A determination of the most desirable size and shape of mortar test specimens and the relation of tension to compression. 3. A determination of the most desirable size and shape of concrete test specimens.

Impurities Affecting Fine Aggregates.—The work of this subcommittee is as follows:

1. In securing samples of fine aggregates which have shown abnormal results when used for concrete. 2. To make tests on the samples secured with the view of determining the cause of the peculiar action noted. 3. To find, if possible, an economical corrective for such peculiarities.

In order to secure samples for this investigation, letters were addressed to a large number of persons throughout the United States and Canada, who it was thought might be able to assist in supplying samples of sand which would be of economic importance if the impurities could be removed. Considerable information has been collected concerning sands of this kind. Several samples have been received and are now being subjected to preliminary tests. The tensile and compressive strengths of mortars made from each of these sands will be compared with mortar from standard Ottawa sands, using various brands of portland cement. Chemical analyses will be conducted on the foreign material in the sands, and an effort made to discover some method of treatment which will remove the defects. In searching for a corrective, the commercial aspect of the problem will be kept constantly in mind so that the method of correcting used for each sand will be practical and the most economical one available.

Methods of Tests for Voids, Weights, Density, Specific Gravity and Consistency.—In the standardization of certain of these tests the committee is coöperating with other committees of the society in order to arrive at specifications which will apply to all classes of work. The first series of tests laid out has been with reference to methods of determining weights and voids.

The variables to be standardized are (a) size of measure, (b) method of filling, (c) condition of sand.

Methods of Tests of Coarse Aggregates—The work of this subcommittee is the investigation of methods of tests to determine the suitability of coarse aggregates for concrete to be used under varying conditions.

Available Aggregates for Concrete.—The work of this subcommittee is the compilation of localities throughout the United States where concrete aggregates are available. The coöperation of geologists of the United States Government in the various states will be solicited and also the assistance of engineers. The efforts of the committee will first be devoted to states in which there are few deposits of available aggregates.

Tests of Building Brick

The Brick committee began a series of coöperative brick tests a year or two ago. More than a dozen university testing laboratories joined in the testing, and many brick manufacturers furnished brick for the tests. Compressive strength, modulus of rupture in bending test, and absorption, are determined. The bricks reported on up to the present range in compressive strength from 1564 to 14,982 lb. per sq.in., in modulus of rupture from 187 to 3354 lb. per sq.in., and in absorption from 0.57 per cent. to 27.50 per cent.

New Committees

Extension of the society's work continues steadily. Four new technical committees started work during the past year—on hollow building-tile, on gypsum and gypsum products, on textile materials, and on revision of pipe threads. Their formation was in each case the outcome of an active demand. The hollow tile and gypsum committees have a particularly strong representation of manufacturers.

Already the new committee on textile materials has done productive work. A specification for automobile tire fabrics which it prepared was accepted by the meeting. The gypsum committee has laid out for itself an ambitious program, five subcommittees being organized to deal respectively with gypsum, gypsum plaster, plaster board and block, testing methods, and nomenclature.

Co-operation of Engineers in Publicity Work

Plans for systematic work in educating the public to a better appreciation of engineering and the engineer were discussed at a conference held at Buffalo on June 23 which was attended by a dozen or more prominent engineers. In sending out invitations to the conference a number of matters were suggested on which the coöperation of engineers is desirable, such as a general employment bureau for engineers, passage of legislation in which engineers are specially interested, and coöperation between different societies of engineers. The conference, however, decided to lay principal emphasis on publicity work. The written opinions received from those unable to attend the conference as well as the opinions expressed by those present were generally in favor of this feature. It was felt to be unwise at this time to form an independent organization to carry on such work, and it was deemed best to work instead through existing engineering societies. It is probable that a committee of engineers prominent in different organizations will be organized to formulate definite plans for carrying forward the work. Dr. Frederick H. Newell, Professor of Civil Engineering in the University of Illinois, has been the leading spirit in the movement, in coöperation with C. E. Drayer, of Cleveland, Ohio, who has done such notable work in connection with the publicity committee of the Cleveland Engineering Society.

Flood Protection at Olean, N. Y.—The floods of March, 1913, which wrought so much damage in the Central States also exacted severe toll from Olean, N. Y. Following the disaster a flood-abatement committee was appointed by the Chamber of Commerce of Olean. Its first step was to apply to the Federal government for information regarding flood-protection work that had been done elsewhere in the United States. The committee report which followed was adopted by the mayor and common council, and a bill was introduced in the State legislature in January, 1914, asking for an appropriation of $150,000 on condition that the city bond itself for a like amount. The bill was vetoed by Governor Glynn; but was again passed by the legislature in 1915, and on May 24 was signed by Governor Whitman. The local bond issue was carried on June 18 by a vote of 6 to 1. The proposed flood-protection structures along the Allegheny River, Olean Creek, and their tributaries within the city limits will be erected under the direction of the superintendent of public works. The bill provides for a local commission of five men to look after the city's interests in this matter. The rights-of-way have been secured and the preliminary plans completed; the intention is to start construction without unnecessary delay.

News of the Engineering World

Report on Chicago Railway Terminal Improvements

The Chicago Railway Terminal Commission, organized in May, 1914, has issued its preliminary report, which was submitted to the City Council Committee on Railway Terminals in March. John F. Wallace is chairman of the commission. The general recommendations may be summarized as follows:

1. The railway terminals in the district bounded by Lake Michigan, Chicago Ave., Desplaines St. and 16th St. should be readjusted and simplified by combination and coöperation. Many railway officials favor this suggestion.

2. The through passenger service of all the railways now using terminals east of the south branch of the Chicago River should be combined in one (or two) union stations, with the exception of such roads as can be taken into the new union station on Canal St., west of the river.

3. The suburban service should be given the advantage of existing opportunities for through routing of traffic.

4. The river should be straightened between Polk and Dodge St., eliminating the present bend and enabling three streets to be extended as continuous north-and-south thoroughfares. This is provided for in some of the ordinances for terminal improvements and is approved by some of the other roads affected.

5. No carload freight should be handled within the congested district, except that intended for consumption and use within the district. It should be handled by cooperative methods and facilities outside of the district, as in the case of clearing yard of the Chicago & Western Indiana R.R. (ENGINEERING NEWS, June 17, 1915).

6. Outbound less-than-carload freight should not, as a general rule, be sorted or loaded to destination at the freight stations in the congested district, but should be loaded into trap cars and taken to outlying transfer stations or yards. Such yards should be operated jointly by the railways.

7. Union freight stations should be established within the congested district, taking the place of separate stations for individual roads. In this way freight for any or all roads may be delivered at one station or freight house and the necessary sorting and transfer made at outlying points.

Buffalo Meeting of the American Society of Mechanical Engineers

The summer meeting of this society was held at Buffalo June 22-25 with over 400 members and guests in attendance. The meeting was especially noteworthy for its excursions to points of interest in connection with manufacturing industries and the scenic wonders of Niagara Falls, the entire day Wednesday being spent there and a session being held in the auditorium of the Shredded Wheat Co.'s factory.

A notable feature of the meeting was a conference of the secretaries of the local sections of the society in different cities. The principal questions discussed were the amount of financial support the national society should extend to the local section, the relation between the local section and the local engineering society in the same city and the use or disposition to be made of papers read before the local section. After an extended discussion, there appeared to be general agreement that the amount of aid extended by the national society to local sections must vary with the circumstances of the different sections. It was further the opinion that the manner in which the money should be expended should be left to the discretion of the officers of the local section, but an accounting should be rendered to the parent society.

Regarding the relations between the local section and the local engineering society, the prevailing opinion was that the local section should if necessary merge itself in the local society, which should be open to engineers in all branches of the profession. A good example of this is the situation at Buffalo, where the strong and prosperous Buffalo Engineering Society has been developed out of what was originally started as a local section of the American Society of Mechanical Engineers.

The number and attractiveness of the excursions offered and the specialized character of most of the papers presented at the meeting combined to limit the amount of discussion. Among the papers of interest presented was one describing the use of heat treatment for improving the quality of the metal in an axle shaft for a motor truck. The shaft was a 2¼-in. diameter chrome-nickel-steel bar with an ultimate strength of 105,000 lb. per sq.in. and an elastic limit of 90,000 lb. per sq.in. Some improvements were made in its design to avoid concentration of stresses, and by subjecting the shaft to heat treatment the elastic limit of the material was raised to 175,000 lb. per sq.in. The cost of this heat treatment is between 2 and 2½c. per lb. and the strength of the material is nearly doubled.

The concluding paragraph of the paper was as follows:

> Alloy steels properly heat-treated are indispensable for motor-truck work, as their capacity to resist fatigue is very great. The writer looks forward to their extended use in other fields of mechanical engineering. As a permanent repair, the heat-treated piece of steel is in many cases worth its weight in gold.

A paper by F. W. Dean, of Boston, Mass., on the use of corrugated furnaces for vertical fire-tube boilers reported excellent results from the use of such furnaces. The elimination of stay-bolts is a very important advantage. In a paper on the influence of disk friction on turbine pump design, the author, F. zur Nedden, concludes that while smoothness of both disk and casing is necessary for high efficiency, the smoothness attained by ordinary machining is as good as high polish. The most important

consideration is to keep the surface of both disk and casing as small as possible. High pressures are more economically produced by high speeds or a larger number of stages than by increasing the diameter of the impellers.

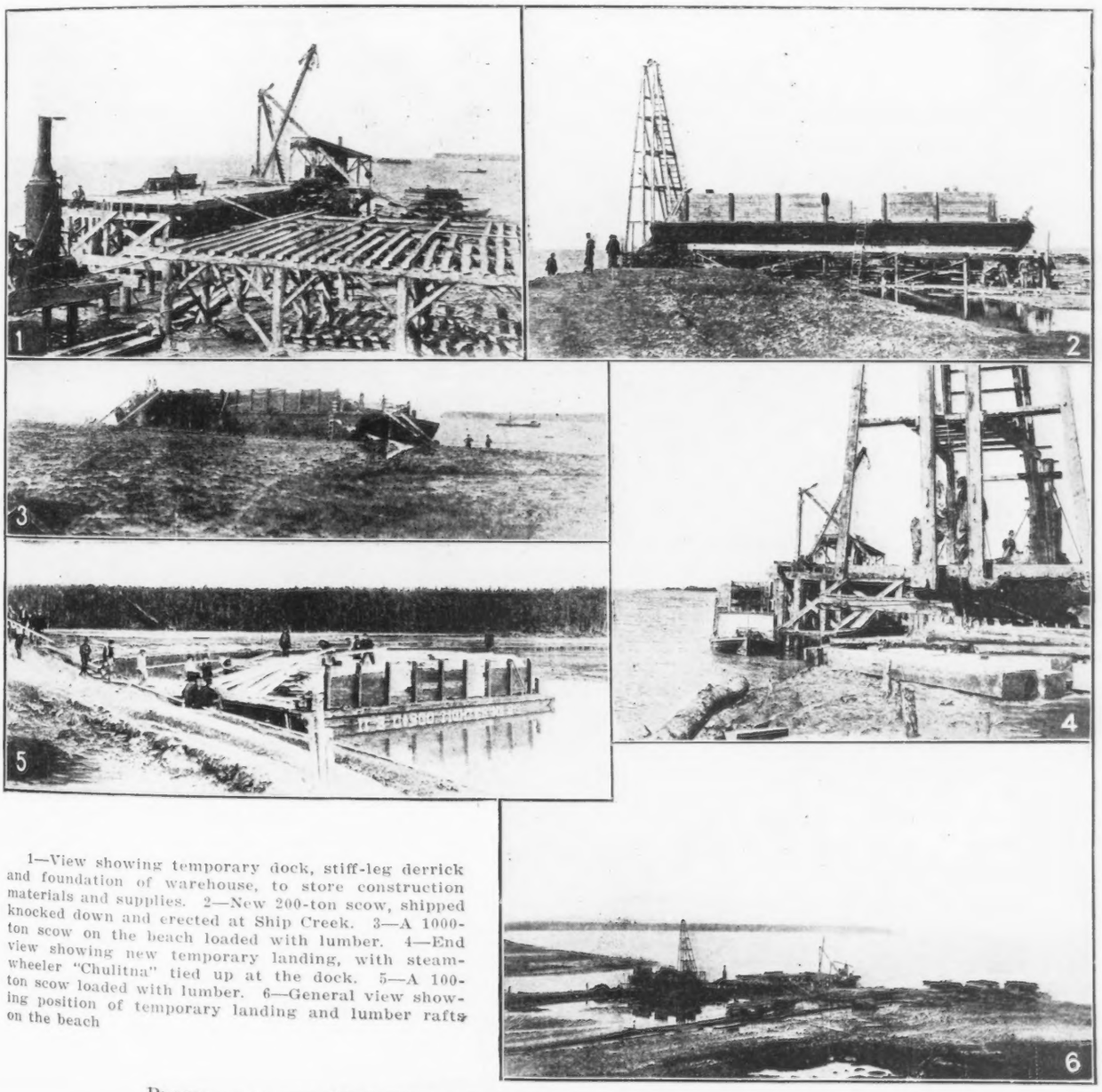
A general meeting of the society is to be held at San Francisco in September just preceding the National Engineering Congress.

Progress on the Alaskan Railways

Construction work on the government railways in Alaska began at Ship Creek, Cook's Inlet, on Apr. 26, when Lieut. Frederick Mears, member of the Alaskan Engineering Commission, and a number of engineers and laborers arrived. The illustrations and what follows are from Lieut. Mears' preliminary report to Secretary Lane of the Department of the Interior.

A complete piledriver outfit and an experienced crew began work as soon as the equipment could be landed and set in place. The dock completed on the right bank of Ship Creek, near the mouth, is equipped with a 15-ton stiff-leg derrick operated by a hoisting engine. This derrick takes the loads out of the scows in nets or large packages and places them on the dock or on a flat car. A gridiron with pile foundation was constructed to furnish level bases for the scows to rest upon when lying at the dock at low tide, and this enables lighters to be unloaded at all stages of the tide. Demurrage charges would amount to $150 to $200 a day. A 1000-ton barge has also been purchased for use as a floating dock.

Contracts had been made with about 400 stationmen, and about 100 men were employed on force account by June 1. No difficulty has been experienced in securing all the stationmen required. A force of between 1500 and 2000 men will soon be at work. By using water transportation it will be possible to start work at several points.



1—View showing temporary dock, stiff-leg derrick and foundation of warehouse, to store construction materials and supplies. 2—New 200-ton scow, shipped knocked down and erected at Ship Creek. 3—A 1000-ton scow on the beach loaded with lumber. 4—End view showing new temporary landing, with steam-wheeler "Chulitna" tied up at the dock. 5—A 100-ton scow loaded with lumber. 6—General view showing position of temporary landing and lumber rafts on the beach

PROGRESS ON THE GOVERNMENT RAILWAYS IN ALASKA; SHIP CREEK TERMINAL

Construction camps have already been established at Eagle River and Peters Creek, 10 and 22 miles respectively from the terminus.

Engineering Conventions Scheduled for San Francisco

Engineers who intend visiting the Panama-Pacific International Exposition in September will be interested in the following list of engineering-society meetings to be held in San Francisco. From Aug. 19 to Oct. 20, two hundred fifty-seven congresses, conferences and conventions are scheduled. From these we have selected a list of 29 meetings which are of the most direct interest and importance to engineers.

AMERICAN ASSOCIATION OF RAILROAD SUPERINTENDENTS.
Aug. 19-21. Secy., E. H. Harman, Room 101, Union Station, St. Louis, Mo.

INSTITUTE OF RADIO ENGINEERS.
Sept. 13-18. Secy., David Sarnoff, 71 Broadway, New York.

PAN-AMERICAN ROAD CONGRESS.
Sept. 13-18. Secy., E. L. Powers, Road Builders Association, 150 Nassau St., New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 16-18. Secy., Charles Warren Hunt, 220 West 57th St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Sept. 16-18. Secy. Calvin W. Rice, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Sept. 16-18. Secy., Bradley Stoughton, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Sept. 16-18. Secy., F. L. Hutchinson, 29 West 39th St., New York City.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Sept. 16-18. Secy., J. J. Blackmore, 29 West 39th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY.
Sept. 16-18. Secy., J. W. Richards, Lehigh University, South Bethlehem, Penn.

INTERNATIONAL IRRIGATION CONGRESS.
Sept. 20. Secy., Arthur Hooker, Sacramento, Calif.; until Aug. 1, New Stockton, Calif.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Sept. 20. Secy., F. F. Sharpless, 52 Broadway, New York City.

PACIFIC COAST ASSOCIATION OF PORT AUTHORITIES.
Sept. 20 and 21. Secy., Leo V. Merle, Ferry Bldg., San Francisco, Calif.

AMERICAN MINING CONGRESS.
Sept. 20-22. Secy., J. F. Callbreath, Washington, D. C.

INTERNATIONAL ENGINEERING CONGRESS.
Sept. 20-25. W. A. Cattell, Secy., Comm. of Management, Foxcroft Bldg., San Francisco.

INTERNATIONAL ASSOCIATION OF BRIDGE AND STRUCTURAL IRON WORKERS.
Sept. 20-30. Secy., Harry Jones, American Central Life Bldg., Indianapolis, Ind.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Sept. 21 and 22. Secy., F. M. White, Madison, Wis.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Sept. 23 and 24. Secy., W. H. Ross, 154 Nassau St., New York City.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 23 and 24. Secy., H. M. Wilson, Bureau of Mines, Pittsburgh, Penn.

AMERICAN ASSOCIATION OF REFRIGERATION.
Sept. 23 and 24. Secy., J. F. Nickerson, 431 South Dearborn St., Chicago, Ill.

ILLINOIS GAS ASSOCIATION.
Sept. 27. Adjourned meeting. Secy., H. H. Clark, 72 West Adams St., Chicago, Ill.

SAFETY CONFERENCE.
Sept. 27 to 30.

INTERNATIONAL GAS CONGRESS.
Sept. 27 to Oct. 1. Secy., George C. Ramsdell, 29 West 39th St., New York City.

AMERICAN GAS INSTITUTE.
Sept. 27 to Oct. 1. Secy., George C. Ramsdell, 29 West 39th St., New York City.

NATIONAL DRAINAGE CONGRESS.
September, 1915.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.
Oct. 4-9. Secy., E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTRIC RAILWAY MANUFACTURERS' ASSOCIATION.
Oct. 4-9. Secy., H. G. McConnaughy, 165 Broadway, New York City.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION.
Oct. 4-9. Secy., E. B. Burritt, 8 West 40th St., New York City.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Oct. 12-16. Secy., William H. Connolly, care Interstate Commerce Commission, Washington, D. C.

AMERICAN FORESTRY ASSOCIATION.
Oct. 20. Secy., P. S. Risdale, 1410 H St., N. W., Washington, D. C.

Benjamin F. Isherwood

At his home in New York City, on June 19, at the age of 93 years, occurred the death of Benjamin Franklin Isherwood, one of the most distinguished members of the engineering profession in a generation long since passed into history. He was a man whose actual experience dated so far back in engineering annals that it seems incredible so many and so great changes could have occurred within the span of one man's life. He was Engineer-in-Chief of the United States Navy during the whole of the Civil War.

Benjamin F. Isherwood was born in New York City, Oct. 6, 1822. His father was a physician, and his great-grandfather, Captain Du Clos, was a distinguished French engineer and a member of Lafayette's staff during the

Benjamin F. Isherwood

American Revolution who had settled in this country following the war and married into the famous Stevens family of New Jersey. Isherwood was educated at Albany Academy and then entered railway work as an assistant to William C. Young, Civil Engineer of the Utica & Schenectady R.R. (now part of the New York Central Lines). William Lake, afterward a distinguished British engineer, was then Resident Engineer and Isherwood's immediate superior and instructor.

From railway work he went to New York City, where he was employed on the staff of John B. Jervis, Chief Engineer of the Croton Aqueduct, then under construction, and later to the engineering department of the Erie R.R. under Charles B. Stuart, Division Engineer of the rail-

way and subsequently Engineer-in-Chief of the U. S. Navy. After this railway experience Isherwood was employed by the U. S. Treasury Department on lighthouse construction. In this connection he was sent to France to superintend the making of lighthouse lenses after his own designs.

Upon the organization of the Engineer Corps of the United States Navy, Isherwood was among the first to be appointed a member, and at the outbreak of the Mexican War (1846) he began his sea service on the "Princeton," the first screw steam vessel of the navy, built by Ericsson as an experiment. His steam engineering studies therefore began with the navy's earliest experience with steam as a motive power. As Chief Engineer of the "Spitfire" he subsequently took part in every naval action of the war.

From this time began his systematic study and solution of an infinite number of problems then facing the steam engineer and naval architect. He inaugurated a system of experiments, planned researches and conducted investigations in many fields. In 1859 were published the results of some of his work in two volumes of "Engineering Precedents," which was the first attempt of any importance to study the duty of steam engines in connection with their indicated horsepower, their losses by friction, the losses in transmission and the net energy expended in propulsion of the ship. About the same time he wrote the chapter on American railroad bridges for Weale's monumental British work on bridge engineering.

Isherwood's fame as a steam engineer was greatly increased by his experiments on the "U. S. S. Michigan," which were published in two volumes, one in 1863 and the other in 1865. This work was undertaken by the direction of the Navy Department in 1860, and its results created a tremendous impression among engineers the world over, for some of his conclusions were revolutionary in respect to principles which until that time had been firmly held to. Here was first pointed out the practical limit to the use of expansion in a single engine cylinder, beyond which further expansion of the working charge produces a net loss rather than a gain. His deductions were eventually admitted to be unquestionable, and Isherwood attained a very high rank among engineers throughout the world. His work made possible the development of the multiple-expansion engine.*

In spite of his arduous duties in building up a navy of 600 vessels during the Civil War, he continued his scientific and engineering researches, and his eight-year term as Engineer-in-Chief (1861-1869) closed with a most extraordinary record of accomplishments, both for the United States Navy and the engineering profession.

For many years afterward he lived in retirement in New York; but his habits of mind and his inclinations led him to continue his studies and investigations and to make some valuable translations from French engineering literature. In 1894 he was elected an honorary member of the American Society of Mechanical Engineers.

*For interesting account of some of the experiments on the "Michigan," see "Engineering News," Dec. 27, 1906, p. 682.

Little Damage by Kansas Floods

During the recent floods (ENGINEERING NEWS, June 24, p. 1243) the Missouri and Kansas Rivers reached higher stages than in the destructive floods of 1904 and 1909, but the damage done was practically nominal. The protection of the levees and revetment of the two rivers has proved effective, the streams flowing under control between the new and prescribed banks.

The levees of the Kaw at and above Kansas City were erected under the direction of the Kaw Valley Drainage Board, by means of assessments over the district, at a cost of $2,000,000. In most cases the railroads have raised their bridges to conform with the elevation of the tops of the levees, which were designed to hold a flood almost equal to that of 1903. The few railroads that had not raised their tracks and had cut approaches to bridges through the levees, were compelled to fill the cuts with sandbags as the waters rose this year, and the flood was kept out of the lowlands.

During the spring there was a contest between the Drainage Board and the Kansas City Southern R.R. on the rebuilding of the latter's bridge over the Kaw River at Kansas City. The present structure is of three spans, and the west abutment is about 40 ft. from the levee, the track between being carried on piling. The flood of this year indicated danger from the piling and the low level of the structure, and when the high rise of the middle of June approached, the Drainage Board received instructions and authority from Governor Capper of Kansas to blow up the approaches if necessary to prevent the bridge from damming waters and causing an overflow. Three railroads

BRIDGE OF THE KANSAS CITY SOUTHERN R.R. OVER THE KAW RIVER

using the Chicago-Great Western R.R. bridge near the mouth of the Kaw were ordered by the Drainage Board to remove sandbags and rock placed against the pile approaches to hold them firm against rising water, but the railways secured an injunction restraining the Board from tearing out the approaches or damaging the bridge.

On June 19, when it seemed certain that the Kaw would rise to a dangerous height, officials of the Kansas City Southern R.R. ordered the piling approaches removed from the west end of the bridge. The water rose until it lapped the girders, as shown in the illustration, even with the current flowing through the channel left where the piling was removed.

The Worst Railway Accident on Record

The collision which occurred on the Caledonian Ry. at Gretna, England, on May 22 was the most serious railway disaster that has ever happened in Great Britain or,

as far as we recall, in any other country since the railway era began. The total number killed was about 162, with 200 injured. Only two railway accidents have ever occurred in the British Isles which at all compare with this in the number of lives lost. One of these was the famous Tay bridge disaster in 1879, when a bridge across the Firth of Tay, near Dundee, Scotland, was blown down in a terrible storm while a train was crossing and every one of the 60 persons on board perished. Ten years later at Armagh, Ireland, a long excursion train had to be split in two in order to ascend a steep grade. The first half of the train was left at the top, while the locomotive went back for the rest of the train. To keep the cars on top of the grade from running back down the hill the wheels were spragged with wooden blocks (for at that day railway cars on remote lines in the British Isle, were not always provided with brake gears). By some means these blocks became displaced and the cars ran back down the grade, colliding with the ascending portion of the train and killing 80 persons.

The Gretna disaster, therefore, caused more than double the loss of life of the worst previous railway disaster in British railway history. The principal facts concerning the Grertna collision, as now reported in London *Engineering* and *The Engineer*, are as follows: The accident occurred at a block signal station known as Quintin's Hill, where there are two sidings (which at the time of the accident were filled with freight trains) and two main tracks for north- and south-bound trains. A northbound local train arrived at 6:30 a.m., and the signalman on duty, in order to clear the main track for a northbound express, switched the local train onto the southbound main track to wait until the northbound express had passed. Two minutes later the day signalman arrived, and, forgetting that the local train was standing on the southbound track, he gave a "line-clear" signal to the next signal box, allowing a southbound troop train to come into the block. A curve prevented the engineer of the troop train from seeing the standing local train until he was close upon it. The collision blocked both tracks, and very shortly afterward the northbound express ran into the wreck at high speed. Fire followed the collision and nearly a score of cars were burned. From the account of the collision there was apparently no track circuit control of the block instruments, so that the sole reliance for safety was on the signalman's records and accuracy.

Investigation showed that while the day signalman should have relieved the night man at 6 a.m., they actually made the change at 6:30. In order to prevent this irregularity from being discovered by the inspectors, records of trains after 6 a.m. were made on a piece of paper and not on the train register and were copied in the train register by the man who later came on duty.

A Broken Dike at Fairfield, Neb., caused by a flood in the Little Blue River on June 18, resulted in the washing away and damaging of a number of summer cottages.

A 36-in. Sewer Settled for 75 ft. of its length and broke, in Council Bluffs, Ia., recently. The ground in the vicinity is cracked and caved to a width of 20 ft. The accident was caused by heavy rains loosening the sand on which the pipe lay. Press dispatches state that the settlement began two weeks previous to the break. To repair this sewer sheet-piling was driven all around the break, and the earth surrounding the pipe was excavated to a width of 6 ft. The sewer is 14 ft. below the street surface and lies in 2 ft. of quicksand. Two lengths of pipe were laid in 1½ days. About 25 lengths were required to make the repair.

A Severe Earthquake shook the Imperial Valley in California on the night of June 22. Nine lives were lost, eight of them in the town of Mexicali across the border in Mexico. Damage estimated at half a million dollars was done to buildings in various towns. The irrigation system from the Colorado River, on which the Imperial Valley is entirely dependent for its water-supply, was not injured by the earthquake. A telegram from C. R. Rockwood, engineer of the Imperial Irrigation District, to "Engineering News" states that there was no interruption of water service anywhere on the canal system. One wooden structure was damaged by a landslide, but can be repaired at a cost of $1000. The protection levees along the Colorado which guard the Imperial Valley from overflow were uninjured.

A Railway Passenger Station in Oakland, Calif., to cost $1,000,000, is to be built by the Southern Pacific Co. The Oakland City Council has passed an ordinance authorizing the proposed construction and requiring work to begin within six months. A 12-story office building will be erected in connection with the station.

A Change in the Tread Contour of Car Wheels has been proposed, reducing the taper of the tread from the present standard of 1 in 20 to 1 in 38. It is claimed that the present standard taper is responsible for increased rail renewals and is severe upon the wheel. This proposition was noted in the report of the Committee on Car Wheels presented at the recent annual convention of the Master Car Builders' Association. It is the opinion of the committee that such a change will be detrimental to the wheel, but the committee will give it consideration if it can be shown that it will be of such benefit to the rail as to offset any bad effect upon the wheel. The matter is to be investigated jointly by this Association and the American Railway Engineering Association.

Fair Treatment of Subcontractors by general contractors was discussed editorially in our issue of May 27 (p. 1041), in connection with the action taken by the Master Builders' Association of Boston. Action has just been taken by the Bridge Builders & Structural Society of New York in opposition to general contractors who, after using a bid which they have received on steel fabrication in their own bid for an entire work and receiving the award of the contract, seek to obtain still lower prices from competing concerns. To meet this condition the Bridge Builders & Structural Society will seek to have engineers and architects receive separate bids for steelwork, apart from the general contract, wherever the amount involved is 250 tons or more.

The Bill for Licensing Structural Engineers in Illinois, backed by the Western Society of Engineers, has made two definite steps, having been amended to meet some objections of the architects and having been passed (as amended) by the House of Representatives. The amendments were made under an agreement between the engineers and the architects, and their effect is to limit the work of engineers to buildings which are commonly recognized as engineering structures, such as manufacturing plants, power houses, etc. In consequence, the Illinois Society of Architects and the Illinois Chapter of the American Institute of Architects have withdrawn their opposition, although it is understood that the State Board of Examiners of Architects continues its opposition. The bill is now in the Senate, where some minor amendments (agreed to by the architects) will be offered.

Two Passenger Trains on the Western Maryland Ry. came together in a head collision on High Bridge, a mile and a half west of Thurmont, Md., at 5:45 p.m., June 24. Six persons were killed and many others injured. An investigation to fix responsibility was begun on June 25 by the Interstate Commerce Commission. The direct cause of the collision, which was between the accommodation train bound from Hagerstown to Baltimore and the Blue Mountain express from Baltimore to Hagerstown, seems to have been an error committed by the Hagerstown dispatcher. High Bridge is about 35 mi. from Hagerstown, and is about 90 ft. above a road at the bottom of a ravine on the eastern slope of the Blue Ridge Mountains. The wreckage on the bridge was cleared away before 7 p.m., June 25. One of the cars hung over the edge of the bridge. To recover this car a temporary trestle was built from the bridge under the car so that the falsework supported the load until locomotive cranes lifted the car back to the track. The bridge was not badly damaged. Owing to a sharp curve just at the bridge the enginemen of the two locomotives were unable to see each other until they were both on the bridge. The brakes were applied, but with little result, as the trains were too close to each other. In addition to the investigation made by the Interstate Commerce Commission inspectors, the railway began an investigation on the morning of June 28.

A Department of Engineering and Public Works for New York State was discussed on June 25 before a joint committee of the Constitutional Convention. Representatives were present from the Committee of Engineers representing national and local engineering societies which favor the control of the proposed department by a commission appointed by the Governor, with terms of office such that a new member of the commission might be appointed by each successive governor. Arguments in favor of this system were presented editorially in "Engineering News" of June 17, p. 1186. Arguments before the committee were made by Messrs. Nelson P. Lewis and Ernest P. Goodrich. Prof. Olin R. Landreth, of Schenectady, a member of the Constitutional Convention, has introduced a bill by which the proposed department would be under control of the state engineer, with certain matters of general policy determined by the Canal Board, which is made up of various state officers ex officio. This plan of organization was advocated by Robert E. Horton, of Albany. Professor Landreth's bill has been indorsed in its essential details by the Albany Society of Civil Engineers and by the Society of Engineers of Eastern New York. Mr. Horton said that the existing system of a state engineer who is a constitutional officer backed by a deliberative body such as the Canal Board has much good in it and should not be discarded unless the system to be adopted in its place can be proved to be better. Other speakers were Albert E. Cluett, of Troy, former State Engineer H. A. Van Alstyne, Edwin A. Fisher and George A. Ricker, late Deputy Highway Commissioner. All the speakers favored consolidation of the engineering work of the state into one department and only disagreed as to whether that department should be under one man or controlled by a commission.

PERSONALS

Mr. S. Ennes, General Superintendent of the Western Maryland Ry., has been appointed General Manager of the road, his old position being abolished. His headquarters will be at Hagerstown, Md.

Mr. E. I. Cantine, M. Am. Soc. C. E., Chief Deputy to State Engineer John H. Lewis, Assoc. M. Am. Soc. C. E., has been placed in charge of all highway work in the State of Oregon initiated since May. 22

Mr. F. M. Fuller, Jun. Am. Soc. M. E., Consulting Engineer, Duluth, Minn., has been appointed General Manager of the Park Point Traction Co., of that city, to succeed J. B. Crane, M. Am. Soc. M. E., removed to New York.

Mr. T. J. Cosgrove, formerly of Cosgrove Bros., Stone Contractors, and recently a member of the New York City Building Code Revision Commission, has resumed business as a cut stone contractor after several years rest owing to ill health.

Mr. John H. Boschen, President of the Commonwealth Savings Bank, has been appointed Assistant Commissioner of Public Works of Manhattan, to fill the vacancy caused by the appointment of Mr. Ralph Folks as Commissioner of Public Works. Mr. Boschen will receive a salary of $6000 a year.

Mr. E. A. Kingsley, Assoc. M. Am. Soc. C. E., of Temple, Tex., has been selected as Paving Engineer of San Antonio, Tex., under the commission form of government. For the past year Mr. Kingsley has been Supervising Engineer in charge of the roads being constructed in the Temple good roads district of Bell County.

Mr. M. P. Paret, M. Am. Soc. C. E., formerly Assistant District Engineer of the Pacific District of the Interstate Commerce Commission, has been appointed District Engineer. Mr. Charles H. Byers has been appointed Assistant District Engineer. The district headquarters are in the Wells Fargo Building, San Francisco, Calif.

Mr. C. W. Reinhardt, technical illustrator, 120 Liberty St., New York City, formerly chief draftsman of "Engineering News," has joined the firm of Winters & Cahill, technical illustrators, Times Building, New York City. Hereafter the firm will be known as Reinhardt, Winters & Cahill, Inc., with offices at the latter address.

Mr. B. G. Slining, formerly Vice-President of the Southwestern Engineering Co., of San Antonio, Tex., has severed his connections with that firm. Mr. Slining expects to spend several months in Chicago, returning in the late summer to San Antonio, where he will take up the investigation of several hydraulic developments.

Mr. E. B. De Vilbiss, Assoc. Am. Inst. E. E., Electrical Engineer, at Fort Wayne, Ind., of the Pennsylvania Lines West, has been appointed Assistant Engineer of Motive Power, with headquarters at Toledo, Ohio. Mr. W. A. Stockbridge, Assoc. Am. inst. E. E., Inspector of Motive Power, at Fort Wayne, will succeed Mr. De Vilbiss as Electrical Engineer.

Messrs. F. F. Prentiss, Vice-President of the Cleveland Twist Drill Co.; William G. Mather, President of the Cleveland-Cliffs Iron Co.; Morris A. Black, President of the H. Black Co.; O. P. Van Sweringen, Agent for the Shaker Heights Land Co. and Director of the Cleveland & Youngstown R.R. Co., and H. M. Farnsworth, President of the County Park Board, have been appointed members of the newly organized City Plan Commission of Cleveland, Ohio.

Messrs. C. Rupert and J. H. Callahan, Brick Contractors, have gone into partnership under the firm name of Rupert & Callahan, with offices at 1306 South 2nd St., St. Joseph, Mo. Mr. Callahan was previously connected with the St. Joseph Construction Co., of St. Joseph and Hutchinson, Kan., and also with the Stamey-Callahan Construction Co., of Hutchinson.

Maj. Wildurr Willing, Corps of Engineers, U. S. A., has been detailed, in addition to his other duties, as inspector and for consultation or to superintend the construction or repair of any aid to navigation authorized by Congress in the Fifteenth Lighthouse District. Maj. Willing will relieve Col. Curtis McD. Townsend, Corps of Engineers, M. Am. Soc. C. E.

The Pennsylvania Co. announces the following changes and appointments: Mr. E. T. Whiter, General Superintendent of the Northwest System, has been promoted to the newly created position of Assistant General Manager of the entire system. Mr. W. C. Downing, Superintendent of the Central System, at Toledo, has been appointed General Superintendent of the Northwest System. Mr. Isaac W. Geer, Superintendent of the Cleveland & Pittsburgh Division, at Cleveland, has been promoted to General Superintendent of the Central System, with offices at Toledo, Ohio.

OBITUARY

Richard Gilpin, Consulting Engineer, Philadelphia, Penn., died, June 21, at Cape May, N. J., where he was spending the summer with his mother. Death was due to pneumonia, aggravated by an attack of heart disease. He was a member of the Engineers' Club of Philadelphia.

Loomis Eaton Chapin, M. Am. Soc. C. E., Consulting Hydraulic and Sanitary Engineer of Pittsburgh and of Canton, Ohio, died recently, at 57 years of age, at his home in Canton, where he had lived for 20 years, serving until 12 years ago as City Engineer. He was a graduate of the University of Michigan. His widow and a son and two daughters survive him.

William MacKenzie Hughes, M. Am. Soc. C. E., Consulting Bridge Engineer, died June 25, at his home in Chicago. He was born at Utica, N. Y., in 1848, and started his business life as a machinist's apprentice. Beginning in 1870, he took a special course at Cornell University, graduating in 1874. He made a specialty of steel bridge and structural work, and was City Bridge Engineer of Cincinnati from 1874 to 1881, of Cleveland from 1883 to 1888, and of Chicago about 1894. After leaving Cincinnati he was in charge of bridge work on the New York, Chicago & St. Louis Ry. During 1889 and 1890 he was Engineer and Assistant General Manager of the Keystone Bridge Co., and from 1891 to 1893 was Engineer of Construction for the Columbian Exhibition at Chicago and of the Metropolitan Elevated Ry. at Chicago. In 1895 he took up private practice, and was engineer for the design and construction of numerous works, including drawbridges over the Chicago River and the Chicago Drainage Canal, part of the Chicago South Side Elevated Ry. extensions, etc. His widow and a daughter survive him.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Aug. 16-18 and 25-28. Annual meeting in Los Angeles, Calif., Aug. 16-18; in San Francisco, Aug. 25-28. Secy., J. C. Olsen, Cooper Union, New York City.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Aug. 24-27. Annual convention in Cincinnati. Secy., Clarence R. George, Houston, Tex.

Colorado Electric Light, Power and Railway Association—The 13th annual convention will be held this year in Glen-

wood Springs, Colo., Sept. 23-25. Thomas F. Kennedy, 303 Fifteenth St., Denver, is secretary.

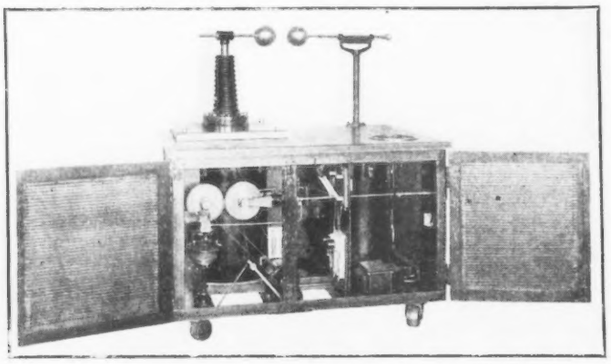
Engineers Club of Baltimore—At the annual meeting held June 3 the following officers were elected: President, Oscar P. Lackey; vice-president, W. Watters Pagon; chairman of house committee, John N. Mackall; members of the board of directors, William Walter Crosby, R. Keith Compton and Ezra B. Whitman. The secretary continues to be William D. Janney. The opening meeting of the club for the ensuing season will be held on the first Thursday in September. The secretary's address is 4 West Eager St., Baltimore, Md.

Appliances and Materials

High-Voltage Insulation Tester

The commercial form of high-voltage, high-frequency oscillator, shown in the accompanying view, has been developed by the General Electric Co., Schenectady, N. Y., to furnish current for testing porcelain insulators and bushings. The outfit requires from about 1.5 kv.-a. at 25 cycles to 2.5 kv.-a. at 60 cycles, and may be used on 110 or 220 volts. It will deliver current up to 165,000 volts and 30,000 cycles. Other sets for 100,000, 250,000 and 500,000 volts are being designed.

The essential elements of the high-frequency oscillator are (1) a step-up transformer (from 110 or 220 to 13,000 volts); (2) a condenser placed across the high-voltage terminals of this transformer, (3) an adjustable control gap, (4) an oscillation transformer with non-ferrous core and consisting of a few turns on the primary and many turns on the secondary, (5) a properly proportioned sphere gap, and (6) a suitable reactance to protect the step-up transformer against short circuit during sparking at the control gap.



HIGH-TENSION TESTING OSCILLATOR

The voltage is controlled by gradually opening the control gap, one electrode being grounded and connected to a rod extending through the side of the case, which permits manipulation while the spark is playing. The high potential of discharge across the sphere gap is read directly in volts from a graduated scale. The fuses and disconnecting switches are mounted inside the frame, the main switch being connected by a rod to a handle just above the control-gap handle.

When a spark passes across the control gap the condenser is short-circuitel and a damped oscillating current surges back and forth through the low-tension winding of the oscillation transformer. Forced oscillations are set up in the high-tension circuit for application to the insulators under test.

The high-frequency oscillator test of insulators is intended to approximate more nearly the conditions under which insulators fail in service. Experience has shown that the high-frequency, high-potential test is not harmful to good porcelain, provided the insulators are properly proportioned and constructed and the electric strain is not carried unreasonably close to maximum limits. Insulators that fail under proper tests would fail under similar stresses in service. In the laboratory good insulators have withstood high-frequency tests by the hour, while imperfect ones have been quickly picked out.

* * *

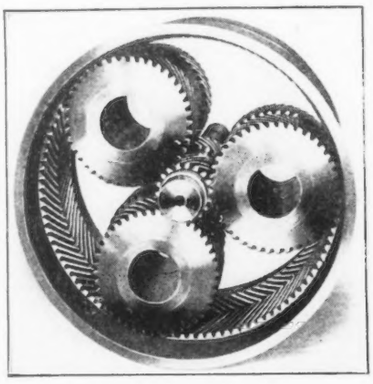
Locomotive Pyrometer

A pyrometer for superheater locomotives is being introduced by the Locomotive Superheater Co., New York. Its purpose is to indicate to the engineman the temperature of the superheated steam. The instrument is of the electrical type, consisting of thermo-couples, having the cold end located in the saturated steam in the steam space of the boiler and the hot end located in the steam chest, directly in the flow of the superheated steam. The former is subject only to slight variations in temperature, owing to variation of pressure, while the latter is subject to a range from that of saturated steam to about 650°. The instrument has a range of 250° to 750°. The difference in electromotive force generated by the two ends is read in degrees of temperature on the dial in the cab. When running, with throttle open, the indicator should register 600° to 650°; if this is not attained it is evidence either that the engine is not being properly handled or that it has not been put in running condition by the roundhouse force.

* * *

Speed-Reducing Gear

A novel mechanical gear for reducing steam-turbine or electric-motor speeds has been devised by the Turbo-Gear Co., Industrial Bldg., Baltimore, Md. It is also used for stepping up speeds where this is desired. The scheme is shown by the accompanying view of the nested gears.



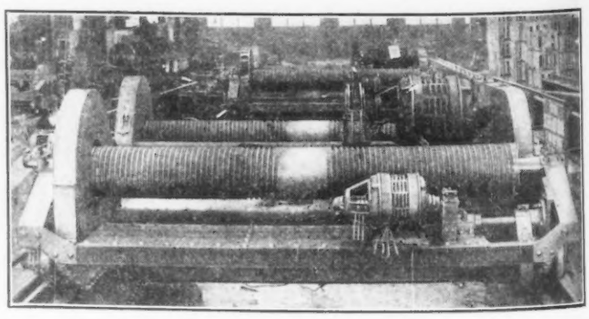
SPEED-REDUCTION GEARS

There is a large internal double helical gear, of openhearth steel, fixed to the casing. Concentric with this is a double helical pinion, of chrome-vanadium steel, on the high-speed shaft. Three parallel intermediate gears of manganese-bronze are on hardened forged-steel shafts carried by the slow-speed shaft which extends out from the casing opposite to the high-speed shaft and concentric with it. The housing is a gray-iron casting, split horizontally and ribbed to give rigidity. An eccentric on the slow-speed shaft drives an oil pump which supplies the high-speed bearings, the discharge flow passing over the gears, which do not run in an oil bath. A ball bearing on each end plate supports the slow-speed member; the high-speed shaft is carried by a babbited bearing on one plate and a bronze socket bushing in the slow-speed gear frame. Only one type is now furnished. This is 30 in. high and occupies an overall space 38x28 in.; speed ratios of from 8.5 : 1 to 16 : 1 are secured for high-speed shaft speeds of 500 to 6000 r.p.m. The weight is 1200 lb. An efficiency of 95 per cent. is guaranteed, but 98 and 99 per cent. are reported to have been reached on test.

* * *

Traveling Cranes with Platform Hoists

The novel design of the traveling crane shown in the accompanying view has been developed by the Cleveland Crane & Engineering Co., Wickliffe, Ohio, for the assembling shops of the Ford Motor Co. at Cleveland, Cincinnati, Pittsburgh, Atlanta and Long Island City. They will be used in unloading freight received in bulk on the ground level and



CRANE FOR FORD SHOPS

conveying it to staggered platforms projecting from the floors above into the crane runway. The main hoists have a capacity of 50 tons; four ropes wind up on drums 8 ft. apart, the maximum lift being about 86 ft. The main hoist is driven by a 40-hp. induction motor (a new design just brought out by the Westinghouse Electric & Manufacturing Co.). The bridge and trolley motors are of 11 and 5 hp. respectively.

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Electric Hoist of the Hamilton Inclined Railway*

New hoist equipment, with a variety of novel features, has been installed by the Hamilton Mountain Park Co., Ltd., at Hamilton, Ont., making the Hamilton Inclined Railway probably the "largest passenger incline in the world." The difference in elevation between the general level of the city and the plateau back of the bluffs is 325 ft. As the roads leading up the bluffs are necessarily steep, the inclined railway handles a very large and miscellaneous traffic—transporting passengers, freight, automobiles, trolley cars, teams etc. The railway was formerly operated by a steam hoist, but this became inadequate to the requirements of increased speed and safety.

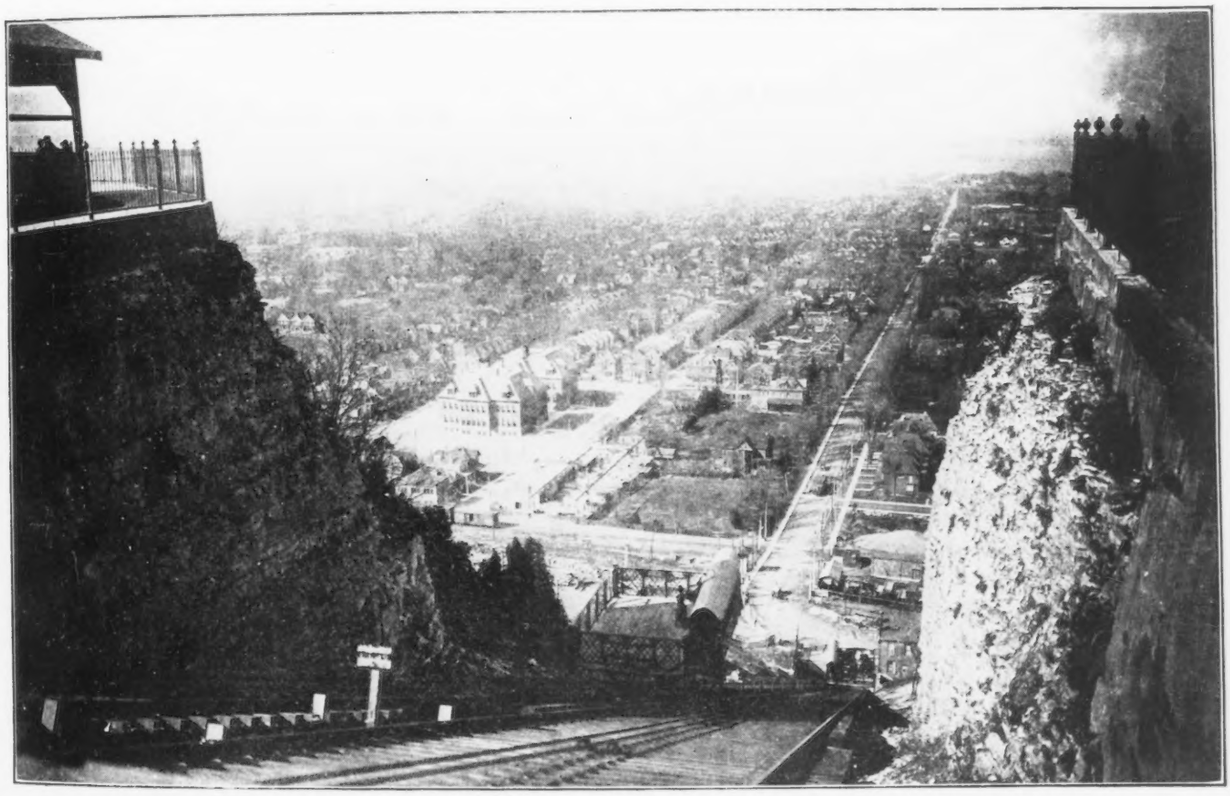

FIG. 1. HAMILTON MOUNTAIN PARK INCLINED RAILWAY AT HAMILTON, ONTARIO

THE INCLINED RAILWAY

Two large platform cars are carried in balance on an inclined double track 800 ft. long, having a grade of 40.3 per cent. The track gage is 12 ft. 1½ in.; each car weighs 30,000 lb.; the average car load is 20,000 lb., the maximum being 30,000 lb.

Two 1⅝-in. ropes, weighing 1.15 lb. per ft., run from each car to a special double fixed-drum double-geared electric incline hoist. One rope is for haulage; the other is a safety cable. The average rope speed during a run is 585 ft. per min. The time of a single trip is 1½ min., and there is a 3-min. rest period between trips.

NEW HOIST

The hoist is located in a house 106 ft. from the knuckle between the incline and the level of the summit. The main rope from the right-hand car is wound over the top of the right-hand hoist drum. The main rope from the left-hand car is wound underneath the left-hand hoist drum. The safety rope from the right-hand car is led over 7-ft. deflecting sheaves to the top of the left-hand drum, while that from the left-hand car is similarly led to the bottom of the right-hand drum.

There are four head sheaves and four deflecting sheaves. The former are arranged vertically so as to carry the

*From information furnished by the Lidgerwood Manufacturing Co., New York City, and the General Electric Co., Schenectady, N. Y.